SCIENTIFIC AMERICAN

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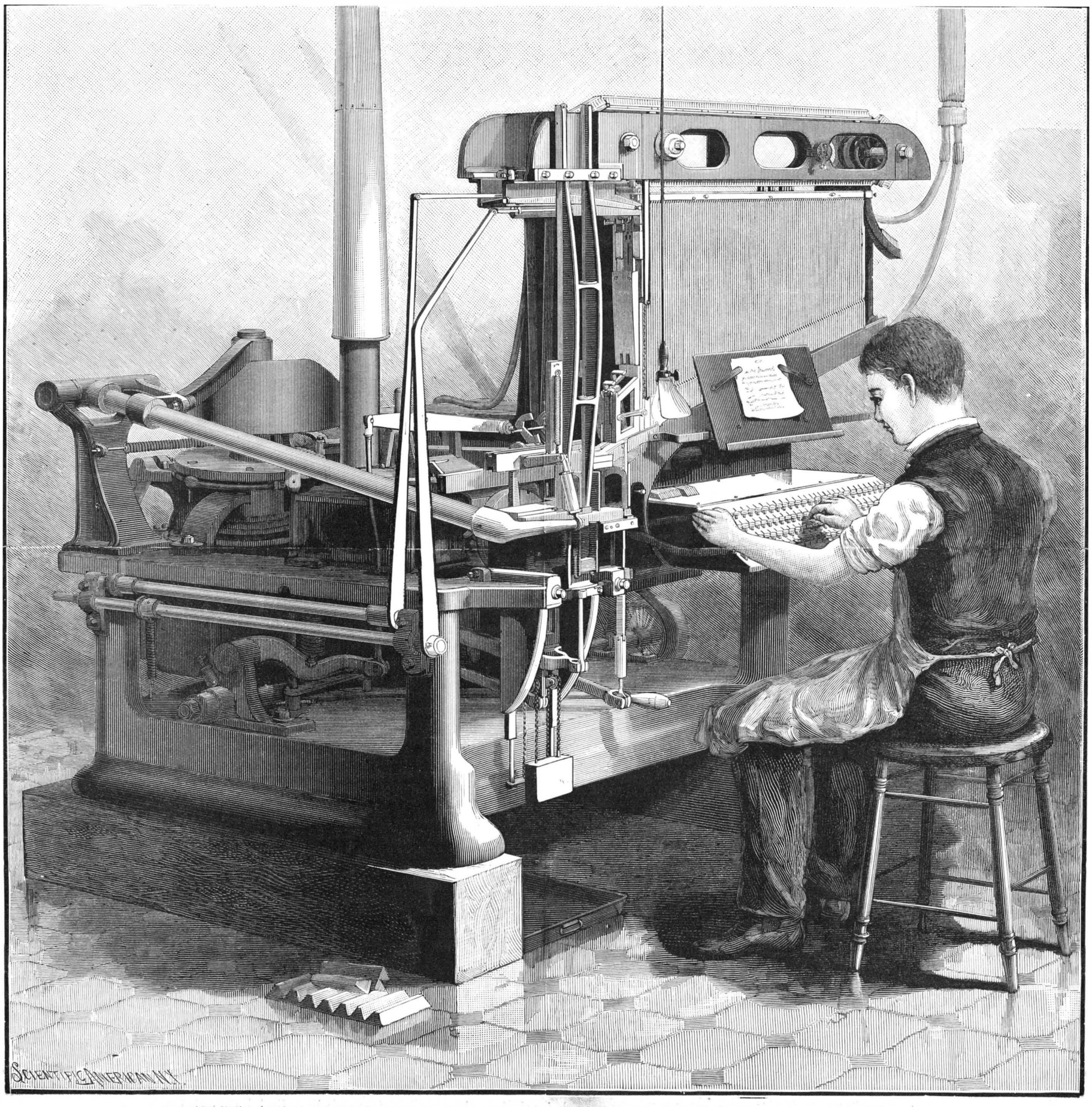
A MACHINE TO SUPERSEDE TYPESETTING.

Prior to January 1, there had been issued from the U. S. Patent Office upward of 160 patents relating to typesetting and type-distributing machines. All such devices, with many others known only in foreign countries, have thus far, however, met with but little favor among printers, and they have not been employed in practical work to a sufficient extent to have any appreciable effect in this most important branch of the printing business. Printing presses have been improved almost beyond comparison with those of the earlier days of the craft—when only about 200 impressions were obtainable per hour from small forms, as against more than 20,000 copies now made per hour of our largest newspapers; but the typesetting part of the making of books and newspapers has remained substantially where it was left by the earliest users of movable types.

The accompanying illustration represents the latest, and in many respects the most remarkable, of the numerous machines which inventors and mechanics have from time to time devised in their long-continued efforts to find some practical means by which to supersede or cut short the tedious work of typesetting. It is known as the Linotype machine, from the nature of its product, but would probably be more generally designated as the "Tribune" machine, from the fact that it has been in practical use in the New York *Tribune* office for more than two years, where it now does substantially all the work formerly done by the compositors of that paper.

It is not, strictly speaking, a typesetting machine, but forms type bars, each of the length, width, and height of a line of type, and the exact counterpart of that which a compositor would set up, except that each line is formed of one entire piece of metal, instead of as many different pieces as there are characters, spaces, etc. A representation of such type bar or slug is given in one of the small views. The key-board in front of which the operator sits has 107 keys, each marked for a capital or lower case character of a fount of type, or the figures, points, or compound letters used in connection therewith, many of the letters most frequently used having several keys. The operative parts are carried by a rigid metal frame, all portions of which are stationary. The "copy" is placed upon a convenient holder just above the keyboard, and above and behind

(*Continued on page* 150.)



SETTING TYPE BY MACHINERY, AS CONDUCTED AT THE NEW YORK "TRIBUNE" OFFICE.

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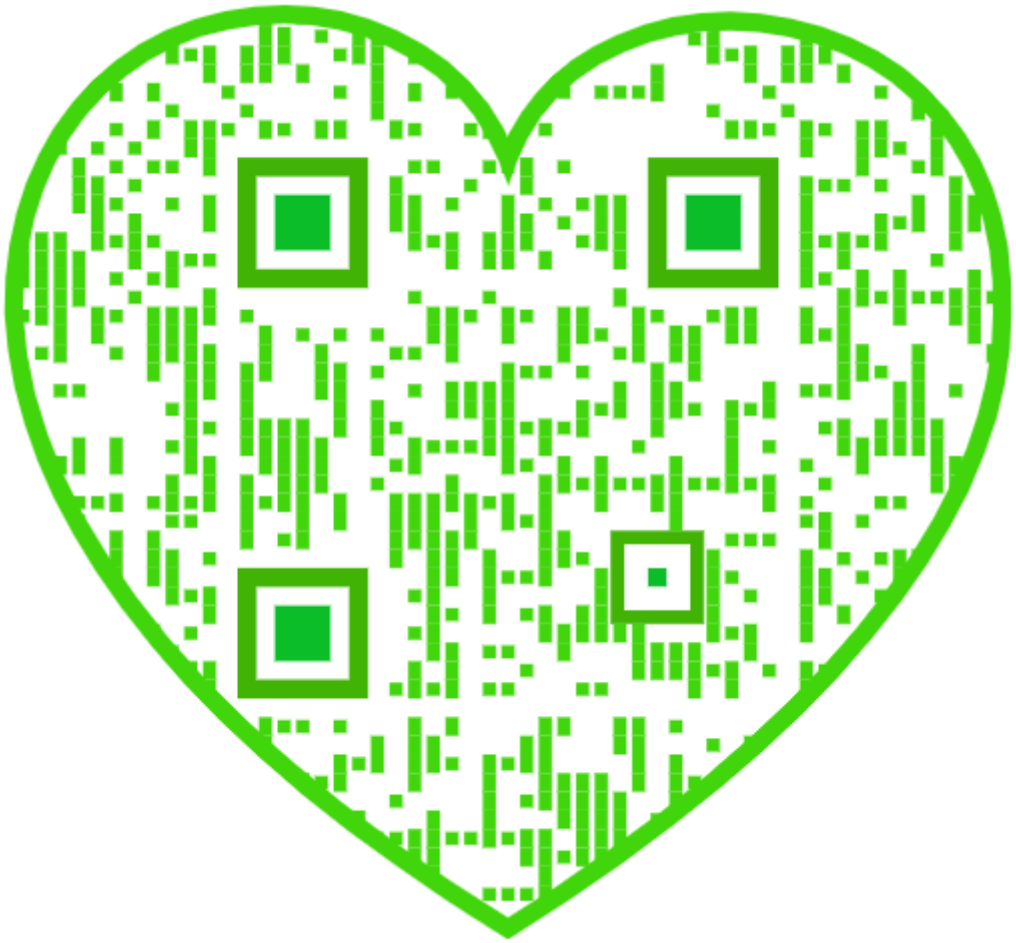

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MEETING OF THE NATIONAL ELECTRIC LIGHTING ASSOCIATION.

Nearly 400 men connected with electrical lighting and kindred industries met recently in Chicago, at the convention of the National Electric Lighting Association, to listen to papers prepared by experts in their several fields, and to discuss the best means of advancing their work. Among the many interesting and timely subjects brought to the attention of this meeting, that of underground service was the most absorbing, because, just now, the most urgent. Long ago the law was invoked to force the wires underground, at least in the large cities, and now that means have been found which, by many informed persons, are thought to be adequate for its proper fulfillment, the public is grown impatient and will not brook further delay. A committee was appointed by the convention that met last August to inquire with careful particularity into, and report upon, the various systems of "underground conduits, with underground conductors and conduits now in operation, and the number of wires actually in use in these conduits." Letters asking for information were sent out to 1,066 local companies; 104 replying, though only seven were actual users. In only one of these cases, as reported by the committee, the user expressed satisfaction with the underground system for currents of high potential. Here are some of the objections taken from a mass of testimony: "The cause of failure has been mainly defective insulation. Even if this question of insulation should be settled, the cost will make it commercially impracticable." "I know of no system to-day which, at any expense, has proved satisfactory, except a system of subways built large enough for men to walk through their entire length." Here are two conflicting opinions; one user says: "Defective mechanical construction, defects in laying, defective conduits, injury to cables in laying, or defective joints have caused very little trouble, the main cause of trouble being defective insulation and deterioration, owing to the presence of gas, water, and steam." Another user says: "My objections to the underground system, as I have used it, are chiefly commercial, partly electrical, and partly mechanical." The seventh man tried, tested his cables under water, but says they did not work satisfactorily, lasting from three months to one and one-half years, the cause being, in his opinion, the effect of the water on the cables and the insulation of the wires.

In summing up, the committee say: "Only in one instance have the experiments or practical workings proved satisfactory, the only other case that was not reported adversely being where the wires had been in operation only 40 days. The average voltage that we used on all the circuits tested was 1,893 volts, the current was 10 amperes, the average thickness of insulation over wires was $\frac{9}{32}$ of an inch, and the average length of cables tested in each case was about 4,600 feet." As to the conduits themselves, there seems to be a decided objection to the use of creosoted wood, most users preferring to bury their wires in the ground itself or in water, and in favor of single conductors. As to whether or no cables should be covered with lead, opinion is divided.

The scene that followed this finding of the committee was in some ways a remarkable one; there being those present who had operated underground conduits for some years, and found them altogether practicable and satisfactory. City Electrician John P. Barrett, of Chicago, said: "We have been using underground electric lighting service here for the last six years. The municipality of Chicago purposes to extend it indefinitely so far as the limits of Chicago are concerned. I was in hopes when I came here to receive some information from other committees. Now it is a singular thing to me to see in this convention men who are prepared to present conduits, prepared to guarantee to construct them and maintain them in any form that you require, and right alongside of them men prepared to furnish conductors that will carry anything you want—in face of that fact, I find it stated by this report that it is an impracticability. We think pretty well of it here, and we have got plenty of it in service. I would be glad to offer any assistance I can to demonstrate that fact."

A well known conduit man said: "I am another aggrieved party. I did not receive a circular. I have been in the electric light business underground for five or six years; operating a plant in Philadelphia during that entire time with perfect and uniform success. We have constructed a plant in New York for the same purpose at a very great expense. The reason they [the committee] say the conduits are not practicable is that they have not seen them. They would not look at them. They have been invited time and again to come and see the practical operation of the conduits, the conductors carrying a voltage which they say is impracticable. In 1883 we laid two miles of conduits in Philadelphia. At the time the state of the manufacture of the insulation was in somewhat primitive condition. To-day they have advanced so that they are willing to offer us wires with a guarantee of three or five years' duration of any insulation that we require. Even with that very weak insulation which we had in 1883, which was made of pure rubber—and they did not understand that a conductor lying in that soft rubber would naturally thin the lower portion out and crowd it up on the top—even with that, some of these conductors, in a year or eighteen months, were working straight along with a Hockhausen machine, and you all know what that machine is.

"It was openly charged, and not denied, though the other side was present, that this Philadelphia underground electrical lighting system was bought out at an enormous advance on its cost by those interested in the overhead system; and though it was working smoothly and paying handsomely, it was utilized for an incandescence circuit, the announcement being made public that arc lighting was not practicable underground."

The defense made by the committee, or rather that made by those of the convention believing in the justness of their finding, was very strong. It having been long since conceded that arc light circuits of 1,000 volts and less may readily be operated underground, the committee had bent their efforts toward learning of successful systems using higher voltage, for by far the major and most important part of the arc light business has this characteristic, and so a committee thus appointed would scarcely have warrant to recommend as already practicable what really was suited to the purposes only of the few—at least as yet.

In the discussion that followed, some very important evidence in surrebuttal was brought out. Here are the vital points of it: The use of high tension currents underground (1,000 volts and over) has up to the present time proved unsatisfactory and impracticable, if not from a scientific standpoint, at least from an economical one; the only circuit of such character now and for some time in successful use being that in Chicago, with a record, so far, of only one year; its projectors having a preponderating advantage over all private companies or individuals in the fact that the municipality of Chicago pays the bills. The following dialogue between two well-informed men on their respective sides, the one interested in conduits and cables, the other a purveyor of light, will serve to give a fair idea of the gist of this matter as represented to the convention:

Mr. Johnstone: . . . "Mr. Cooper's prophecy that Prof. Barrett's expenditure for arc light underground circuits in Chicago will be useless. Pray, how is it that he knows this? He has had no experience with underground circuits."

Mr. Cooper: "Past experience. Mr. President, I should like to ask Mr. Johnstone one question. Can you tell me of any underground wire, either the Johnstone system or any other system, using an arc light circuit of 2,000 or 2,200 volts, that has been in successful operation, not three years, but three months?"

Mr. Johnstone: "The Harlem River Electric Light Company, of New York——"

Mr. Cooper: "I ask you if you have got any such thing in operation?"

Mr. Johnstone: "Not now. We are putting up in 51st Street, New York, something that will show and develop this thing in one month, so that there will be no further questions about it."

Mr. Cooper: "We will wait until the end of the month."

As a result of the discussion, the report was recommitted to the committee, which after being re-enforced was instructed to continue its investigations.

Disruptive Discharges in Lead Cables.—Under this head, C. H. Rudd described some experiments he has been making in the line suggested, at the last meeting of the Association, by A. G. Acheson—experiments which by no means support the theories entertained by that industrious investigator. Mr. Rudd says that the static charge in an ordinary cable is a negligible quantity when compared with the regular current flowing, and the E. M. F. of said charge cannot be greater than the E. M. F. of the current from which it was derived. Hence, in considering the character and thickness of insulation, we have nothing to take account of but the primary pressure which bears upon insulation. Mr. Acheson's second conclusion, viz., that a static charge will not pass an arc, virtually declares an arc circuit to exist as a number of sections in a sense insulated from each other, and in that connection the statement is made that each separate section comes under separate strain every time that the circuit is shut down. We may hold our own ideas concerning the E. M. F. of a static charge, therefore we need not fear that an imprisoned charge would do any more harm than the current did from which it came. If we charge an ordinary condenser from a battery, and the condenser does not break down, we do not fear that it will break down when we disconnect the battery. There is in the minds of some people an idea that static electricity when it begins to move produces a current possessing different properties from currents formed by other electricity under the same conditions. If disruptive discharges occur in properly insulated cables, we must look for the cause in those sources of high pressure which exist in nature. I do not believe that burn-outs can be ascribed to any one

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cause, but that each individual case has its own individual cause.

In practice, we must provide insulation strong enough to meet the daily strain and suitable devices to prevent the accumulation of charge from outside sources of greater pressure than the insulation will bear. As yet we have no proof that high pressure protectors are required anywhere outside of the station from which the wires start. Mr. Acheson says that the greater number of grounds or burn-outs occurring in arc light circuits are at the terminals of the lead, or at the joints, and says that such a state of things would be naturally caused by the greater density of the static charges at these points. Mr. Rudd thinks this to be a singular carrying over of ideas obtained in laboratory work with purely static electricity, and arbitrarily applying them to entirely different conditions. The natural static charge in a cable, due to the distribution of the working E. M. F. of the current in the cable, must necessarily be produced in its distribution by the force from which it originated. The shape of the conductor cannot act in the matter of this kind of static distribution as the shape of an insulated conductor would act upon a purely static charge. As regards burn-outs that occur at terminals and joints, great care is required to make these points equal to the rest of the cable in matters of insulation.

Fuel oil, a subject just now attracting a very general attention among electrical lighting men, was discussed at great length. Three papers were read, the writers describing their experiences as actual users, and presenting many facts showing the advantages of the system, which they had gathered during the course of their studies.

S. S. Leonard told of an unfortunate experience his company had had while trying to use oil fuel without altering the furnaces that had been used by his company for coal fuel. They covered the grate bars with fire brick, so the heat would not injure them, put in the burner, and turned on the oil. As a result, the oil was not all burned, and ran down into the ash pits, where it gave no end of trouble. Now, with proper furnaces, they are finding oil fuel offers great advantages. They have been using it now eighteen months. During the first part of the night seven boilers are in use, the engines being 1,100 H. P. The steam pressure is easily maintained at any desired point. He finds that one man can attend to from seven to ten 150 H. P. boilers. One fireman at night and one during the day they have now, against three by night and three or four by day as formerly. As to whether or no oil is cheaper than coal, it depends on the relative difference in cost of the two, and hence to the locality. In Minneapolis, where his plant is, Illinois lump coal costs from $3.25 to $3.60 per ton, while Eastern coals are worth from $4.50 to $5.50 per ton (bituminous). The oil costs at present 2½ cents a gallon, delivered.

In comparing tests with oil and coal, he finds that 2½ barrels, or 104 gallons, costing $2.60, will evaporate as much water as one ton of coal, costing $3.15, a saving of about 21 per cent in favor of oil. With one pound of coal he evaporated 5·38 lb. of water. One ton of coal would, therefore, evaporate 10,760 lb. water. With oil, 14·8 lb. of water were evaporated per pound of oil. Oil weighs about 7 lb. to the gallon. One gallon oil would, therefore, evaporate 103·6 lb. water. With oil at 2½ cents a gallon, it would take 126 gallons to cost the same as one ton of coal, viz., $3 15; 126 gallons oil would evaporate 13,053 lb. water, while one ton of coal evaporates 10,760 lb. water, being a difference of 2,293 lb. in favor of the oil, or a saving of 21 per cent. He believes that he is saving at least 15 per cent, and perhaps 20 in fuel alone.

M. J. Francisco said one pound of coal contains 12,000 heat units, while 1 lb. of petroleum furnishes 20,000. Engineers of experience, familiar with the practical workings of coal, know that under the most favorable conditions not more than 10 lb. water can be vaporized per pound of coal, while petroleum shows a vaporization of 18 lb. water for every pound of oil consumed, estimating in both experiments the feed water at 212° F. The heat in coal transferable to water is about 70 per cent, while the heat in petroleum transferable to water is about 80 per cent. Therefore with coal 70 per cent of 12,000 units gives 8,400, and for petroleum 80 per cent of 20,000 is 16,000—a gain of 7,600 heat units in each pound.

This is on the basis of pure coal, but when we consider the waste, amounting in some cases to 25 per cent—and the master mechanic of one of the largest railroads in the country claims 55 per cent found in nearly all coal—such as sulphur, slate, and earthy substances, which, being incombustible, retard instead of generating heat, the difference in the per cent obtained in actual practice is far greater than shown by the above comparison. On this basis the only question to be considered is the cost of power furnished by each at the dynamo. Three and one-half barrels or 955 lb. of oil equal 2,240 lb. of pure coal, therefore, with oil at $1 per barrel and coal $3.50 per ton, or oil at $1.50 per barrel and coal $4.50, the difference in cost would not be marked if there were no other factor to be considered. When, however, we calculate the great saving in stoking, removing cinders and ashes, cleaning flues and benefit to boiler, besides securing a steady heat, combined with quickness and ease in starting and shutting down, we have an argument in favor of oil that stockholders that care for dividends can appreciate. Oil can be delivered at Rutland, Vt., for $1.50 per barrel, while soft coal costs $4.40, and hard $6 per ton. On this basis, allowing five pounds of coal per hour, twelve hours per day, 1,000 H. P. requiring 803 tons per month, at $4.50 would cost $3,613.50; two firemen to feed same, $100; man cleaning flues, etc., $45; carting ashes and cinders, $100; making total cost for thirty days, $3,858.50 with coal. Same number H. P. and same length of time, allowing three and one-half barrels for each ton of coal, would require 2,810 barrels of oil at $1.05 = $2,950.50. Wages of one man in boiler room, $50; making total of cost of 1,000 H. P. one month, with oil, $3,000.50, showing a saving of $858 per month, besides the advantages, where oil is used, of steady flow of steam and regularity of speed.

Mr. Francisco has gathered these facts: The Boston and Albany Railroad Company, after a careful test, made in their shops by a Lehigh University professor, say that the cost of fuel is about the same; though they buy their coal in large quantities at one time, and secure low rates, they prefer liquid fuel, because it is clean and requires no fireman, and gives a better supply of steam.

Day, Cordage & Co., of Boston, claim that, with Cumberland coal at $4.50 per ton and liquid fuel at $1.15 per barrel, they save fifteen cents per 100 H. P. per hour, and the oil is preferable.

The Fairbanks Scale Co., of Vermont, report that they find it a great saving over coal, while the boilers are heated evenly the entire length. The manager of the Toledo, Columbus, and Southern Railway reports a saving of 33 per cent of the price of coal by using liquid fuel, and that two barrels of oil equal one ton of soft coal, while manufacturers on his road find it only costs one-half as much as coal for their stationary boilers. The rolling mill works of Chicago use it under a battery of fourteen boilers, and say that $3\frac{6}{10}$ barrels oil does the work of one ton of coal. Formerly, when using coal, twenty-five men were needed to work this battery of boilers for twenty-four hours; now, with liquid fuel, four men do the work, the efficiency of the boilers is increased, cost of repairs lessened, and the flame less severe on boilers.

A paper on municipal lighting was read by F. H. Whipple, and on municipal ownership of commercial monopolies, by A. R. Foote.

POSITION OF THE PLANETS IN MARCH.

VENUS

is evening star. Her period of greatest brilliancy occurs on the 25th, when, as well as during this whole month, she shines like a young moon, casts a shadow, and is visible at noonday in the presence of the sun himself. After that time her light grows dim, as she rapidly approaches the sun and draws near the close of her career as evening star. Her movement northward will increase the length of her stay above the horizon, and place her under most favorable conditions for observation. Venus sets on the 1st at 9 h. 42 m. P. M. On the 31st she sets at 9 h. 38 m P. M. Her diameter on the 1st is 27″.8, and she is in the constellation Pisces.

SATURN

is evening star. He is easily found in the northeast, as soon as the stars come out, from his vicinity to Regulus. A quadrilateral may be traced, formed by Saturn, Regulus, and two other stars belonging to the Sickle, Gamma and Epsilon Leonis. Saturn sets on the 1st at 5 h. 30 m. A. M. On the 31st he sets at 3 h. 28 m. A. M. His diameter on the 1st is 19″, and he is in the constellation Leo.

JUPITER

is morning star. He is fair to behold as he looms above the southeastern horizon on the 1st, more than three hours before sunrise. He is in quadrature with the sun on the 27th, and is then 90° west of the sun. Jupiter rises on the 1st at 2 h. 59 m. On the 31st he rises at 1 h. 15 m. A. M. His diameter is 33″.6, and he is in the constellation Sagittarius.

URANUS

is morning star. He is now near enough to the earth to be visible to the naked eye, and, rising on the 1st about 9 h. P. M., may be found about 2° north of Spica, as a small star of the sixth magnitude. Uranus rises on the 1st at 9 h. 3 m. P. M. On the 31st he rises at 7 h. P. M. His diameter is 3″.8, and he is in the constellation Virgo.

MERCURY

is morning star. He reaches his greatest western elongation on the 13th, and is then visible in the east as morning star before sunrise. He is, however, too far south of the sun to be seen under favorable conditions. Mercury rises on the 1st at 5 h. 25 m. A. M. On the 31st he rises at 5 h. 7 m. A. M. His diameter is 8″.6, and he is in the constellation Aquarius.

MARS

is evening star. Our interesting neighbor increases his distance from the earth, but is still visible as a ruddy star, setting on the 1st about two hours after the sun. Mars sets on the 1st at 8 h. 4 m. P. M. On the 31st he sets at 8 h. P. M. His diameter is 4″.6, and he is in the constellation Pisces.

NEPTUNE

is evening star. He sets on the 1st at 0 h. 15 m. A. M. On the 31st he sets at 10 h. 20 m. P. M. His diameter is 2″.6, and he is in the constellation Taurus.

Saturn, Neptune, Venus, and Mars are evening stars at the close of the month. Uranus, Jupiter, and Mercury are morning stars.

PROPOSED VISIT OF THE AMERICAN ENGINEERING SOCIETIES TO EUROPE.

The American Society of Civil Engineers, with the Society of Mechanical Engineers and the Institute of Mining Engineers, are organizing a trip to Europe to visit the Paris exposition and such other objects of interest as may prove practicable. The proposed excursion has attained already such dimensions, as indicated by the responses of members, that it is believed that two steamers will be required to accommodate the travelers. The civil engineers alone will fill one vessel. It is proposed, therefore, to charter one or two vessels of the Inman line, and perhaps to reserve all the first cabin accommodations on the Egypt or Spain of the National line. The maximum fare for the ocean voyage and return will be $110. The magnitude of the delegation indicates well the immense growth of the engineering profession in the United States, and it is gratifying to feel that America is to be so well represented at the exposition. Her position at all previous exhibitions, from the standpoint of inventiveness and ingenuity displayed by the exhibits, has been very high, and will be so in 1889. The engineering societies will give a personal aspect of American professional life that we are confident will make itself felt in scientific circles there.

Burglarizing Bank Safes.

A startling article appeared in the daily papers last week, giving an account of what purported to be the blowing open of one of Marvin's bank safes by two "reformed burglars" (?) connected with the Star Theater company.

We thought the statements were worth investigating for our readers and the many bankers and business men using safes, not only in this city, but throughout the country; for if safes can be broken open in a few moments, it is time users of them knew it. We are glad to say that after fully investigating the facts, we find the whole matter was merely an advertising scheme to puff a cheap play at the expense of a reputable business. The real truth of the matter is that these people bought a little second-hand safe for about twenty dollars of some dealer, to exhibit it in their show and make a pretense of blowing it open during the progress of the play. It is an outrage that such a misstatement should have appeared in the daily papers as would tend to create a feeling of distrust in bank safes.

The Marvin Safe Company has been manufacturing safes for half a century, and no name in the trade stands higher than theirs, and they now have under way for various banks safes that look as though it would take a month to force open.—*The Financier.*

More Industrial Schools.

Mr. Jacob Tome, a wealthy banker of Port Deposit, Md., who some time ago set aside a half million dollars to found a practical training school in the mechanic arts and trades, to be located at Port Deposit, Md., has now increased the gift to two and a half million dollars. With this liberal endowment, and the carrying out of Mr. Tome's wishes, who has himself risen from the ranks of labor and fully understands the difficulties now besetting the youth of our country in obtaining a practical knowledge of the mechanic arts, this school is designed to be one of the most complete and extensive in all branches of trade practice of any similar institution in the world. The scheme of free trade teaching inaugurated by Peter Cooper has at last taken a deep root in the minds of able men, followed by the success of the New York Trade Schools and the Pratt Institute in Brooklyn, N. Y.

The munificent gifts of Mr. Williamson, of Philadelphia, and Mr. Tome, of Port Deposit, Md., are destined to bring out the latent genius and energy of our youth in a practical apprenticeship, free from the depressing influence and obstruction now thrown in the way of the apprentice by the discouraging influence attempted and partially enforced through the perverted dogmas and actions of labor organizations.

THE direct use of electricity as a labor-saving machine has been applied at the great steel works, Cleveland, Ohio, where a large electro-magnet is used, suspended from a crane, to pick up steel bars and billets. It will pick up 800 lb. billets and drop them where wanted by the touch of a key, the movement of the crane being done by steam.

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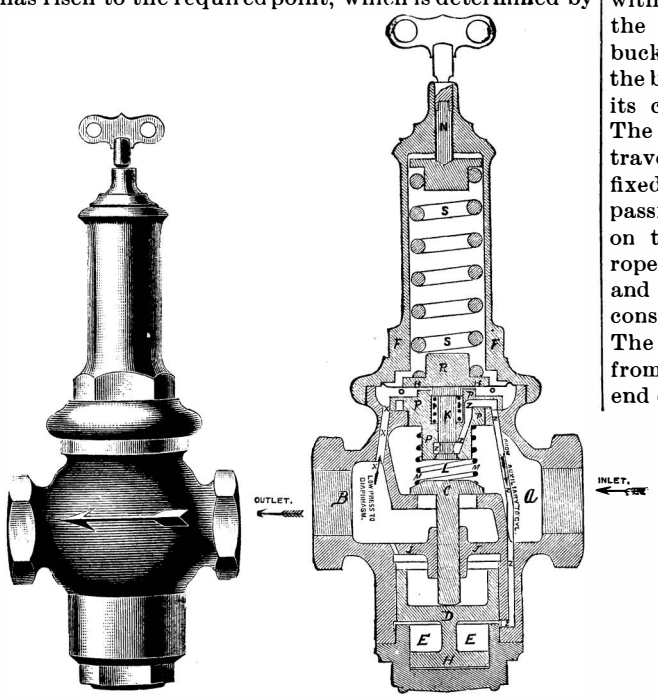
THE MASON REDUCING VALVE.

The accompanying illustrations represent a valve designed to automatically reduce and maintain an even steam or air pressure, regardless of the initial pressure. The principle upon which it operates is that of an auxiliary valve controlled by the low pressure, and admitting steam from the high pressure side to operate a differential piston, which is the main valve. The high pressure enters the reducing valve at the side marked "inlet," and passing through the auxiliary valve, K, which is held open by the tension of the spring, S, passes down the port marked "from auxiliary to cylinder," underneath the differential piston, D. By raising the piston, D, the valve, C, is opened against the initial pressure, since the area of C is only one-half of that of D. Steam is thus admitted to the low pressure side, and also passes up the port, XX, underneath the phosphor bronze diaphragm, OO, upon which bears the spring, S. When the low pressure in the system has risen to the required point, which is determined by

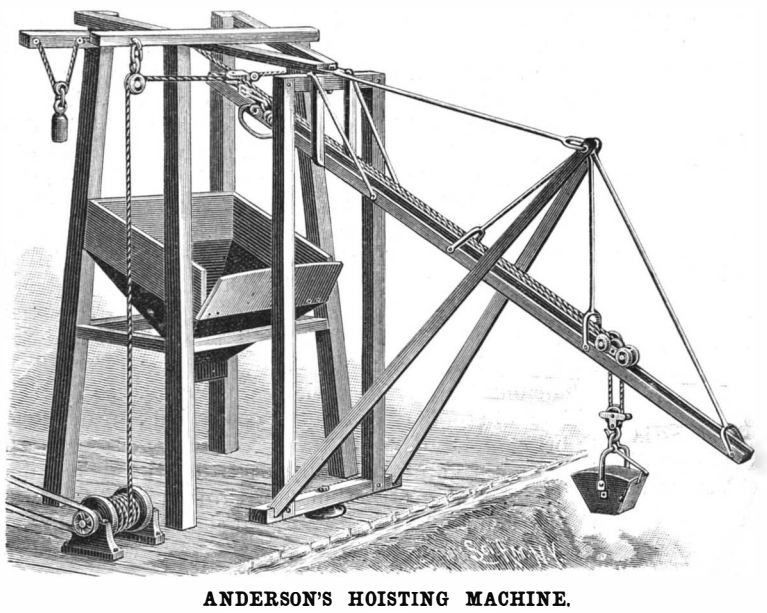


THE MASON REDUCING VALVE.

the tension of the spring, S, the diaphragm is forced upward by the steam in the chamber, OO, the valve, K, closes, no more steam is admitted under the piston, D, the valve, C, is forced on to its seat by the initial pressure, thus shutting off steam from the low pressure side. This action is repeated as often as the low pressure drops below the required amount. This piston, D, is fitted with a dash pot, E, which prevents chattering or pounding when the high or low pressure suddenly changes. This valve is manufactured by the Mason Regulator Company, Boston, Mass., the sizes up to and including two inches being made of composition, and above that of cast iron, with composition linings.

AN IMPROVED HOISTING MACHINE.

An easily operated machine, of which the boom can be swung to any desired position and held there, and specially adapted to facilitate the loading and unloading of vessels, cars, etc., is shown in the accompanying illustration. It forms the subject of a patent issued to Mr. George J. Anderson, of West Superior, Wis. The mast consists of a vertical frame having on its bottom a pin adapted to turn in a bearing on the platform,



ANDERSON'S HOISTING MACHINE.

which may be part of a dock, and there is a pin in the upper end of the mast frame adapted to turn in a bearing in the ends of forwardly projecting top beams of a frame erected in the rear of the mast, the latter frame having a hopper supported therein. Forwardly projecting beams of the mast frame support an inclined boom extending rearwardly over the hopper, this boom being built of parallel beams to form a track for a carrier, and having a trip at its rear end over the hopper, while the beam is held on the mast in such manner that the weight concentrates in the lower part of the mast frame, and the latter is easily turned on its pivots. The carrier, besides the usual wheels, supports a frame, in the middle of which a pulley is mounted to rotate, over which passes the hoisting rope, secured by one end to a transverse bar of the carrier frame. The hoisting rope supports the hoisting bucket by passing under a pulley mounted to rotate in a frame carrying at its lower end a hook, the arrangement being such that the bucket is lifted out of the hold by the hoisting rope until the pulley comes in contact with the pulley of the carrier, when the latter travels upward with the bucket, and a latch connected with the bucket engages the trip to discharge its contents when over the hopper. The desired limitation of the lowest travel of the carrier on the boom is fixed by a rope attached thereto and passing upward over a weighted pulley on the main frame, the end of this rope being secured on a cleat or pin, and the weight causing all slack of the rope to be constantly taken up during the travel of the carrier. The outer end of the hoisting rope extends downward from a pulley in a pivotal connection with the upper end of the boom, to be connected with a windlass of any approved construction on the platform, and one end of the block carrying the pulley at the top of the frame, over which the rope passes, is also connected with a rope extending over a sheave and downward, to be secured to a cleat on the post at the opposite side of the frame. When the boom has been turned to the desired position, this rope is fastened to the cleat, the boom being turned to such position by pulling on this rope or on the hoisting rope.

AN IMPROVED GRATE BAR.

The accompanying illustration represents a style of grate bar now and for five years past in use on the Sound steamers Stonington and Narragansett, which is said to have been very economical and to have given entire satisfaction. These grate bars allow for ample air space through and between them, and always remain comparatively cool on their bottom edges, while the top surfaces become very hot, and sometimes red hot. This fact, in the case of ordinary grate bars, causes unequal expansion, which breaks, buckles, or warps the bar, a proportionate loss of fuel ensuing. In the Miller bar this expansion is allowed for by the lateral air spaces and openings on the face of the bar, whereby the bar is said to remain straight until burned down to the bottom of the openings. Further information relative thereto may be obtained of Chief Engineer John Smith, of the steamer Stonington, or Chief Engineer Wm. H. Van Wart, of the steamer Narragansett, No. 261 West Street, New York City.

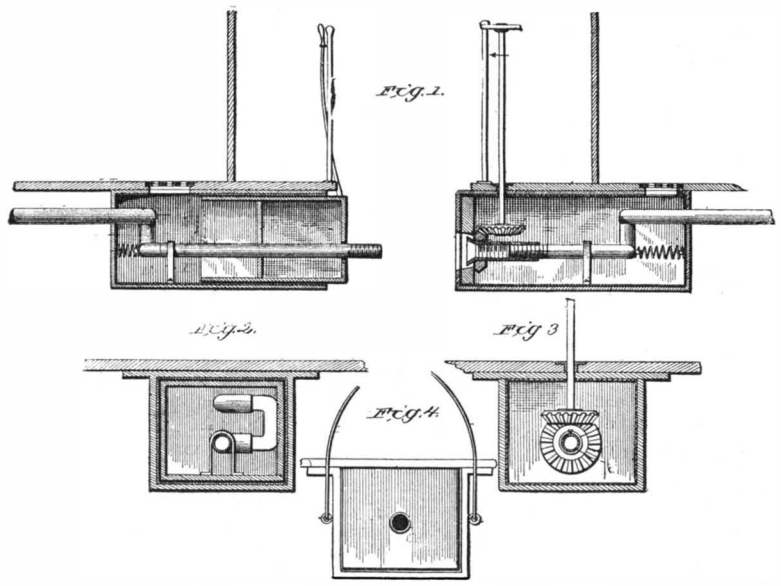
AN IMPROVED OIL CAN NOZZLE.

A nozzle or tip adapted for connection to the spout of any ordinary oil can, to prevent waste of oil, is shown in the accompanying illustration, and has been patented by Mr. John S. Peter, Denver, Col. (care of B. & M. R. RR.). Figs. 1 and 2 show side and end views of the nozzle, which has an interior lengthwise passage or bore, for discharge of the oil, a head piece fitted for rotation within the back part of the tube, and to which the oil can spout is fastened, and a spring held to the head piece and engaging the tube to normally turn the latter out of line with the annular passage of the head-piece, to cut off the flow of oil from the can, as shown in Fig. 3. The spring may also be fitted to the rear end of the head piece, as shown in dotted lines in Fig. 1. In using a can provided with this nozzle, the nozzle or tip is placed in an oiling hole, and the body of the can turned by the operator until the bores of the tube and head piece are brought to coincide, before any oil will be discharged, these parts resuming their normal position to cut off the flow of oil as soon as the tube is lifted from the oil hole. Fig. 4 is a sectional view of a slightly modified form of the nozzle.

GOOD thin shellac varnish.—Break the gum into small pieces and macerate in a stoppered bottle with ether. After swelling sufficiently, excess of ether is poured off, when the shellac dissolves quite readily in alcohol.

THE SARTELL RAILWAY CAR HEATER.

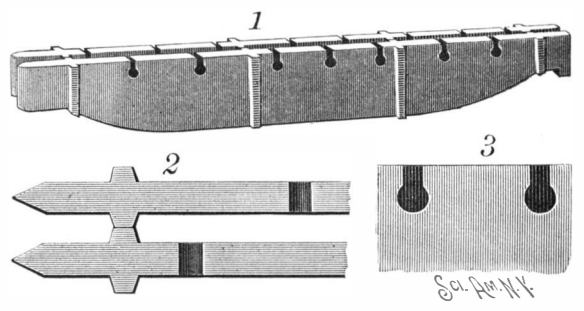
We illustrate herewith a device for heating railway cars recently patented by Mr. E. P. Sartell, of St. Cloud, Minn. Fig. 1 of the accompanying cuts represents a vertical longitudinal sectional view of parts of



THE SARTELL RAILWAY CAR HEATER.

two railway cars provided with the heater ready for use. Fig. 2 is a vertical transverse view of the same. Fig. 3 is a similar view, showing a different section. Fig. 4 is a front view of the chest.

The heater chest runs the entire length of car, with attachments underneath at the platform ends. It is lined, and forms an inclosed chamber for steam pipes. On the upper side of the chest are registers, which communicate direct with the interiors of the cars, and when open the heated air from the chest enters into the cars. The source of heat being thus placed *outside* of the cars, the dangers arising from fire in the event of a railroad accident are removed—the apparatus for generation of steam being located in the forward car of the train or coming from the locomotive direct. Provision is also made for instant detachment of steam pipes, consequent on the coupling or uncoupling of cars, these pipes at the same time having a perfect connection

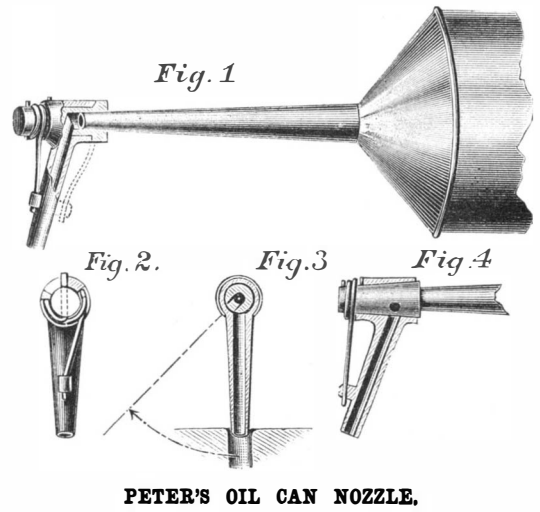


THE MILLER GRATE BAR.

with each other. The pipes are also supplied with proper dripcocks and valves. We are informed that a practical test of this heater is soon to be made on one of our leading railways of the Northwest.

Astrology and Railways in China.

The extension of the Tien-Tsin Railway to Tung-Chow has (the Shanghai correspondent of the *Standard* says) encountered an unexpected obstacle, which, it is to be feared, will prove fatal to its progress, for the present at least. The great fire which destroyed part of the Imperial Palace in Peking recently caused much disturbance in the minds of the old fashioned and superstitious, who are still strong in the capital. In consequence, the Emperor and his mother consulted the imperial astrologers, who, after much deliberation, declared that the fire was an evil omen, and was intended as a warning against permitting the approach of the "Western invention" to the sacred city. The further extension of the railway has been prohibited by imperial decree.



PETER'S OIL CAN NOZZLE.

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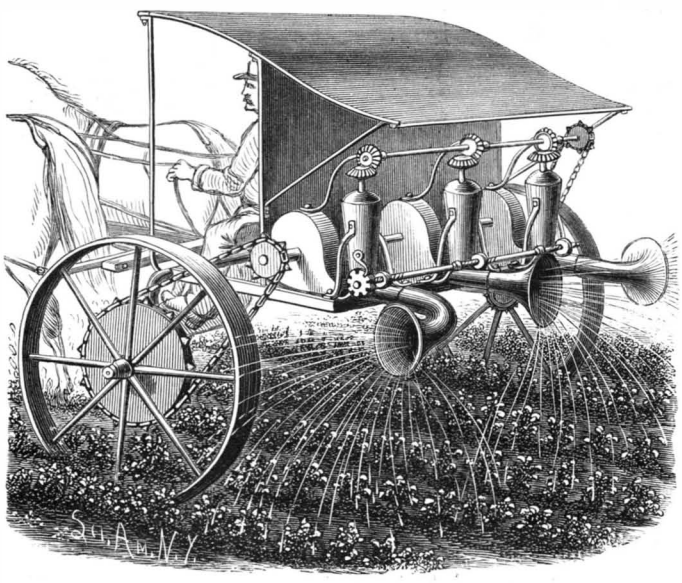
A MACHINE TO DISTRIBUTE POISON ON PLANTS.

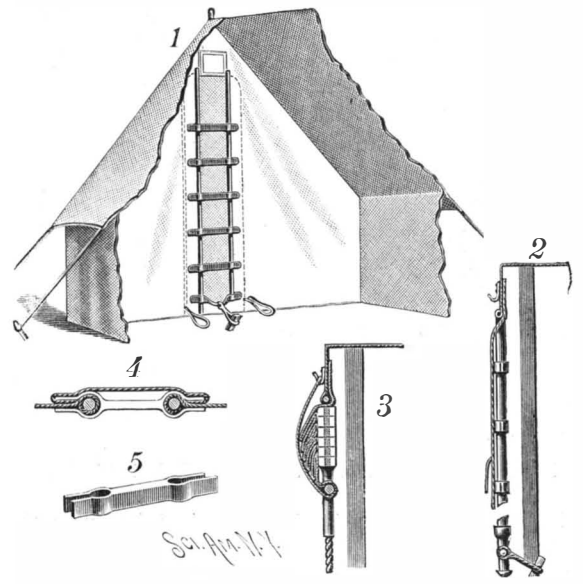
A method of dusting poisonous powders on plants, to rid them of destructive insects, is illustrated herewith, and forms the subject of a patent issued to Messrs. George R. and John W. Brown, of Pledger, Texas. The axle of the machine is centrally arched to pass readily over plants, and the main frame has a screen to protect the driver from the poisonous dust. The casings of the air blast fans are fixed to the rear cross bar of the frame, and have outlet pipes communicating with nozzles having trumpet-shaped ends, the nozzles being so connected as to admit of their being turned in different directions. All three of the fans are operated by a shaft which at one end carries a sprocket wheel, from which a driving chain passes to a larger sprocket wheel on the sulky wheel, causing the rapid rotation of the fans. A hopper to contain the poison is arranged over the outlet pipe of each of the fan casings, and beneath each hopper is pivoted a valve having an opening which may be brought to coincide more or less fully with a hole in the bottom of the hopper, the valves for all the hoppers being simultaneously regulated by a hand wheel and a worm shaft. To prevent the clogging of the poison in the hoppers, a vertical shaft, carrying a winged agitator, is journaled in each, the top of the shaft carrying a bevel gear wheel engaged by a bevel pinion on a transverse shaft, the latter being operated by a driving chain from the sulky axle, and a lever controlling the operation of this shaft being in convenient reach of the driver. This machine may, if desired, be built with but one poison hopper, fan blast apparatus, and discharge nozzle.



BROWNS' MACHINE TO DISTRIBUTE POISON ON PLANTS.

IMPROVED DEVICE TO CLOSE A TENT ENTRANCE.

A device for closing the entrance opening in the wall of a tent readily and quickly, without the tying of cords, is illustrated herewith, and has been patented by Mr. Henry Thomas, Fort Omaha, Neb. The device may be applied to old as well as new tents, and the curtain arranged to operate from either the outside or inside. A suitable section of the tent wall is removed, and the edges of the opening turned over to leave an opening sufficient to receive a vertical guide rope on each side. At the top of the opening a flexible portion of a covering curtain is secured, while to the lower portion of the curtain, at intervals, clips are attached by sewing. The clip is shown in Fig. 5, its enlarged circular portions each embracing the guide rope in one of the edges, as shown in cross section in Fig. 4, Fig. 2 being a vertical section when the curtain is closed, as in Fig. 1. The clips slide up and down readily on the guide ropes, carrying with them the curtain, and to retain the curtain in raised position, as shown in Fig. 3, a cord or loop is attached to the lowest clip, and hung upon a hook secured above to the tent wall. To hold the curtain closed, a loop on the lowest clip is drawn over a tent peg.



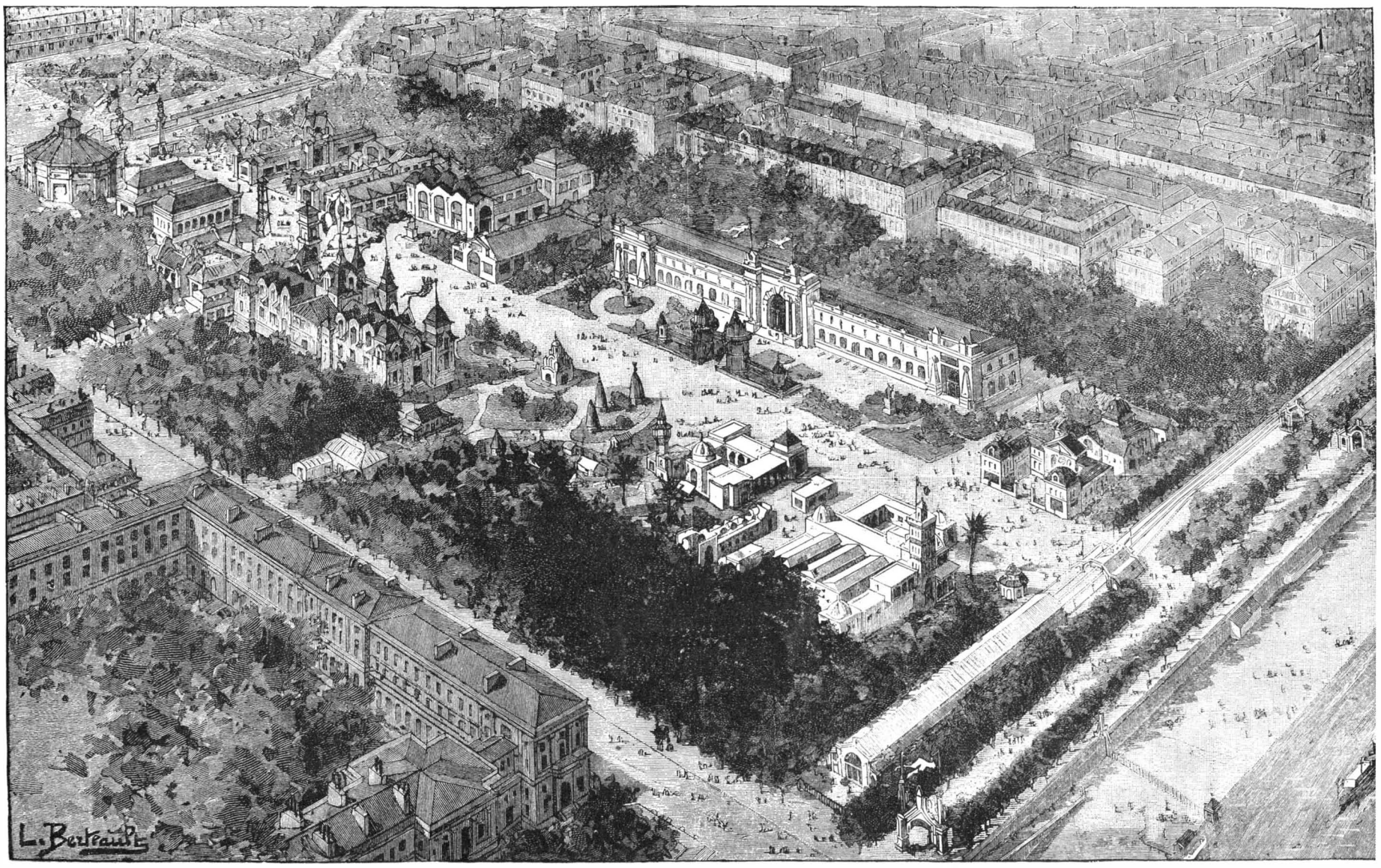
THOMAS' TENT-CLOSING DEVICE.

THE FRENCH EXPOSITION OF 1889 AT THE ESPLANADE DES INVALIDES.

One of the great novelties of the future exposition—and this will certainly be obvious to Parisians—will consist in the fact that one of the monumental entrances of the immense bazar overlooked by the Eiffel tower will be very near the Concord bridge, nearly in the heart of Paris. The colossal palace of iron and steel which is building upon the Champ de Mars will extend its annexes, in fact, as far as to the Esplanade des Invalides, and here will certainly be found one of the most picturesque and entertaining points of the entire exposition. Although most of the structures are as yet unfinished, we wish now to lead our readers thither, and make them share with us the astonishment and admiration that a visit to this city of palaces, which is rising as if by enchantment, has caused us.

There is nothing but minarets, domes, steeples shaped in the Greek style, and white cupolas surmounted by the Oriental crescent; and here is the imposing facade of the exposition of the Minister of War, preceded by a formidable entrance to a feudal castle, an interesting specimen of the military architecture of the middle ages, due to Mr. Walrein, the skillful architect appointed by the Minister of War. Mr. Girault, one of the laureates of our Roman school, designed and is building the pavilion of hygiene, Mr. Ballu that of the Algerian exposition, and Mr. Sauvestre the central pavilion of the French colonies. Further along, there is an Indian temple, then a dwelling like those conceded to the colonists in our New Caledonian possessions, and, above this picturesque decoration, rises, nearly completed, the elegant minaret of the Coubba of Sidi-ben-Avouz, which overlooks the whole of the Tunisian section. This latter, seeing the peculiar interest taken in our new protectorate of Africa, will certainly be one of the principal attractions of the Exposition of the Invalides. The structures of the Tunisian section, the heavy work upon which is now finished, are the ones that, for the moment, give the best idea of what the picturesque part of the exposition will be. Mr. Henri Saladin is the architect of it. Prepared for this work by a trip that he has given an account of in the *Tour du Monde*, in conjunction with Professor Cognat, of the College of France, he has united in the style of his picturesque pavilion the most delightful specimens of Oriental architecture. The arcades of the front were suggested by those of Bardo, the central dome is an exact reproduction of the Mikrab of the mosque of Kerouan, the loggia is that of a Tunisian house. There will be here some souks or covered bazars, an interior court with a pavement of colored tiles, and a cafe is going up under the shade of a group of trees. And all this will be filled at the proper time with the riches of Tunis—fabrics, carpets, ceramics, works of art, and, finally, with all the surprises that could be expected from the organizing zeal and talent with which Mr. Sauson, Commissary General of the Tunisian government, is endowed.

Let us not leave the Esplanade des Invalides with-



THE FRENCH EXPOSITION OF 1889 AT THE ESPLANADE DES INVALIDES.

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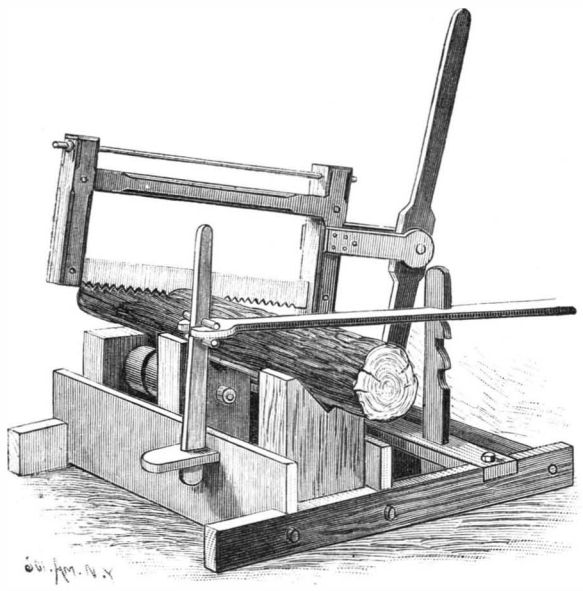
out mention also of the Tonkin village that is to be built there, the English dairies, the Dutch bakeries, and especially the phenomena of All Paris, which we have had the good fortune to get a glimpse of. Mr. Castellani's brush has brought hither the entire Place



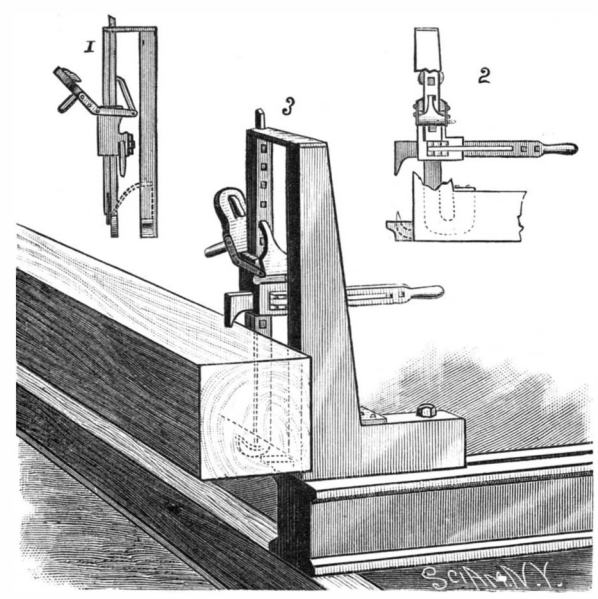
MOSER & BALDWIN'S WOOD-SAWING MACHINE.

de l'Opera, with its marble building, its tall houses, the groups of trees of the boulevards, the distant blues of the avenues, and, under the glowing sun with which he has illuminated his work, nearly a thousand persons are coming and going. There are nearly a thousand portraits of natural size—All Paris, all those who count, all those who are spoken of. There will be here . . . . but why unveil one of the prettiest surprises that the exposition reserves for us? Mr. Castellani can calculate upon success. It is not only All Paris that will visit him, but also all those who care to see the exposition.—*Le Monde Illustre.*

AN IMPROVED SAW MILL DOG.

A dog designed to be easily and quickly adjustable to small or large logs on the carriage frame is shown herewith, and has been patented by Mr. John Flesher, of Edgington, Ontario, Canada, Fig. 1, showing an end and Fig. 2 a side elevation. The standard is secured in the usual manner to the head block, and has upper and lower arms supporting a vertical guide post on which slides a bar having at its lower end an upwardly turned point adapted to engage the log on its under side.

On the inside of the bar are notches adapted to be engaged by a spring pawl pivoted in a lever fulcrumed on a sleeve sliding vertically on both the guide post and the bar, the lever having near its outer end a handle, and a catch adapted to engage the upper pointed end of the sliding bar. On the inside of the sleeve is a notch to hold the spring pawl out of contact with the notches of the sliding bar, and a bar sliding transversely in the sleeve has on its outer end a downwardly extending point adapted to engage the top of the log. This latter bar is moved downward to bring its point in engagement with the log by operating the handle of the lever fulcrumed on the sleeve, its spring pawl engaging the notches of the vertical bar to drive the point into the top of the log. To release the dog, the lever is swung inward, the pawl being thereby disengaged from the notches in the vertical sliding bar, and swinging downward into the recess of the sleeve, when the latter can be moved upward on the guide post and the bar until its catch is engaged by the top pointed end of the bar. The weight of the sleeve and its connections thus resting on the vertically sliding bar, the latter is moved downward and its point disengaged from the bottom of the log.



FLESHER'S SAW MILL DOG.

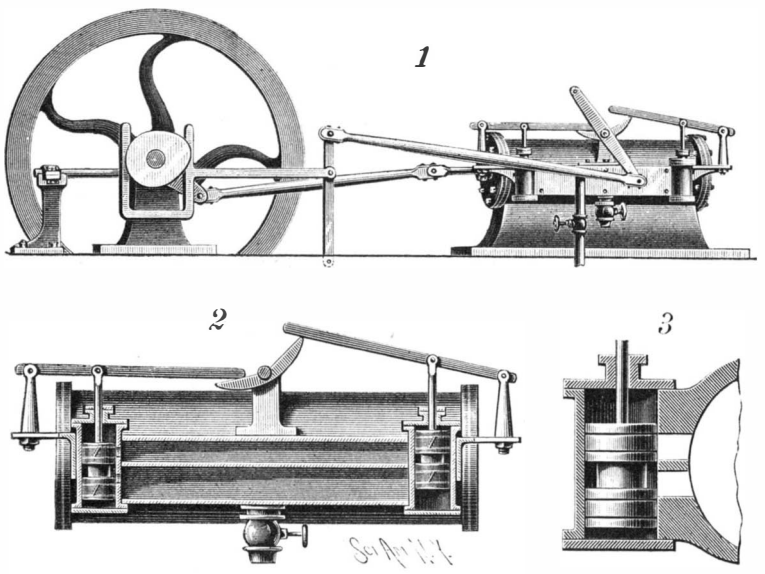
AN IMPROVED WOOD-SAWING MACHINE.

A device to facilitate wood sawing, patented by Mr. Thomas J. Baldwin, is illustrated herewith. The stick to be sawed is placed in notches in the upper end of blocks, fixed in a suitable base frame, in which also is journaled a circumferentially grooved roller. To a bar extending through one side of the frame is secured a standard, with pins adapted to engage a forked lever for holding the stick to be sawed steadily in position, the other end of the lever being engaged by notches in a standard on the other side of the frame. To a shaft journaled in the sides of the base pieces is fixed an upwardly extending lever, which is jointed by an arm to the frame carrying the saw, so that by moving the lever back and forth the saw is reciprocated, and its work effected. When the saw passes through the stick, its teeth engage the circumferential groove in the roller beneath, to rotate the same, and, by filling this groove with hard grease, the blade of the saw is always kept well lubricated.

For further particulars relative to this invention, address Messrs. Moser & Baldwin, care of Howe Scale Co., 612 N. Third Street, St. Louis, Mo.

AN IMPROVED STEAM ENGINE.

An improved valve gear for steam engines, patented by Mr. Ernest Beare, of Chester, Ill., is shown in the accompanying illustration. The steam chest is at one side of the cylinder, extending from end to end, and is divided into two longitudinal compartments, the upper one adapted to receive live steam, while the lower one receives the exhaust. Centrally upon the steam chest is a standard, with a rock shaft carrying upwardly curved fingers, while to the outer end of the shaft, as shown in Fig. 1, a lever is centrally secured, having a wrist pin at each extremity. Upon the drive shaft is keyed a heart-shaped cam, adapted to reciprocate a U-shaped yoke of a horizontal cam rod, pivoted near the center to a vertical link, the lower end of which is pivoted on the engine bed. The upper end of this link is pivotally connected, through a pitman, to one end of the lever secured on the rock shaft carrying the upwardly curved fingers, this lever having a wrist pin at each extremity, so that one may be utilized to go ahead and the other to back up. At each end of the steam chest is a vertical cylindrical casing, shown in detail in Fig. 3, having each a port leading into the live steam and the exhaust steam chambers, and in this casing reciprocates a plunger-like valve, with central circumferential groove, there being a metallic packing ring to take up the wear of the valve. In the rear of each casing are two ports coinciding with similar ports in the cylinder, the ports in the valve casing being just large enough to admit steam into the cylinder and take the exhaust steam. The valve rods extending through the top of the valve casings are each pivotally united to a lever, the outer end of which is pivoted upon a standard, while the inner end of each lever rests upon one of the upwardly curved fingers, so that when the plunger of one valve is down in the casing, the plunger of the opposite valve is elevated. This construction is designed to prevent down pressure on the valves, and obviate the grinding of the valve seats, while the wear of the valves will be effectively taken up by the packing rings.



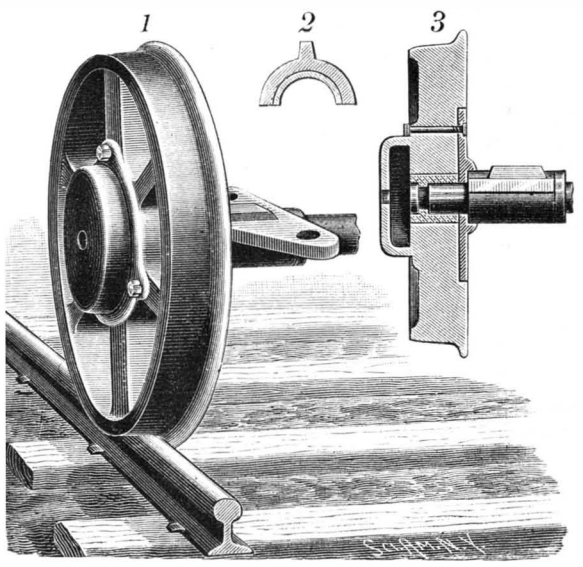
BEARE'S STEAM ENGINE.

Treatment of Warts.

Children often suffer from unsightly warts on the hands, which cannot be removed by caustic. G. B. Pullin, of Sidmouth (Bristol *Medical Journal*), recommends in such cases the administration of two or three minims of liq. arsenicalis twice a day. In a week or ten days, he says, the warts will disappear.

AN IMPROVED CAR WHEEL AND BEARING.

The accompanying illustration represents a wheel in which the end of the axle is protected by an outer cap made integral with the body of the wheel, while to the rear face of the wheel is bolted a cap which serves as an



WILLIAMS' CAR WHEEL AND BEARING.

abutment for the outer face of a bearing arranged for connection with the car body. This invention has been patented by Mr. Jesse S. Williams, of Beaver Dam, Ky. Fig. 3 is a central sectional view, and Fig. 2 shows one of the brasses. The cap has a central aperture, through which the lubricant is introduced, and the hub is formed with recesses adapted to receive flanges upon the brasses, which are made in semicircular sections. The axle has a collar, and in putting on the wheel the axle is first passed through the bearing and the cap placed in position, when the brasses are applied, their flanges resting in a circumferential groove near the end of the axle, and then the wheel is placed on and bolted, as shown in the sectional view.

THE Dayton *Democrat* relates the following, which illustrates pretty well the rapidity as well as extent to which building is carried on these days:

Citizen (to builder)—What are you going to put up there?

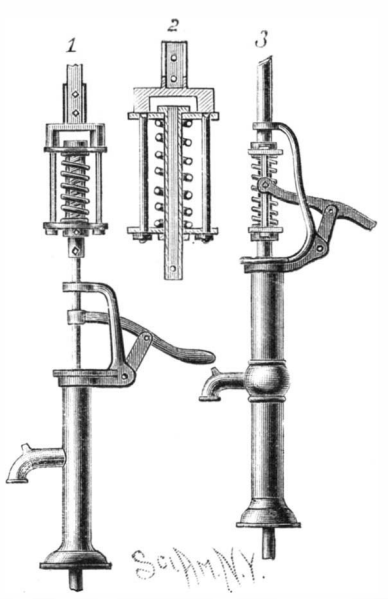
Builder—We're just beginning the finest row of flats ever built in New York City.

Citizen—I'd like a nice flat in this neighborhood.

Builder—Well, you stop on your way home from down town this evening and I'll show you through; but get here as early as possible or they may be gone.

IMPROVED PLUNGER ROD FOR PUMPS.

The accompanying illustration represents an improvement, patented by Mr. Walter C. Westaway, designed to relieve reciprocating pumps and pumping machinery of strain and sudden jar in starting and when in rapid operation. Fig. 1 shows the invention applied to a common windmill pump, with handles for starting and operating by hand, Fig. 2 showing a different application of the handle. On the upper end of the piston rod or plunger is attached a section, on which are placed plates having a coiled spring between them, to act as a cushion, a rod worked by the windmill or other source of power being connected to the plunger rod to act thereon through the cushion. Fig. 2 is a detailed sectional elevation, showing the cushion and coupling. For further particulars relative to this invention address Messrs. H. & L. W. Beard, Decorah, Iowa.



WESTAWAY'S PLUNGER ROD FOR PUMPS.

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Correspondence.

The Origin of Sweet Corn, and Early Use of the Tomato.

To the Editor of the Scientific American:

In your paper of February 16, in a note on origin of sweet corn, it is stated that sweet corn is not referred to by Jefferson in 1781, nor by Thorburn in 1817, nor by Fessenden in 1828. In 1832 it is mentioned by Bridgeman, and by Binot in 1851.

The writer found it in 1815 on the table of Rev. James Freeman, in Newton, Massachusetts, who raised it largely on his farm. The same skillful horticulturist was among the first to raise the tomato, I think about 1818, and I remember how few people could then be induced to taste a fruit now so popular.

S. C. CLARKE.

Marietta, Georgia.

Chimney Ventilation for Sewage Disposal Systems.

To the Editor of the Scientific American:

In reading Dr. Sloane's article, in your issue of February 23, upon "Process of Sewage Disposal," one or two facts occurred to me in illustration and justification of his theory. These facts I think will be seen to be of interest and importance in this connection.

Some years ago, under the escort of Mr. Harrison, then mayor of the city of Minneapolis, Minnesota, I made a visit of inspection to those public buildings and private residences which were warmed and *ventilated* by the "Ruttan patent."

This essentially consists of a central chimney, gauged, as regards its capacity, its height and dimensions, by the cubic area of the building to be warmed and ventilated. The smoke pipe of the furnace is carried up through the chimney, being fastened by clamps to one of the inside corners.

So great was the draught of these chimneys, that a silk handkerchief, released in the cellar opening, immediately ascended and was shot out from the top with great force.

With Mr. Harrison I went down, by a permanent iron ladder, to the very bottom of the lighted vault of a public school building. This vault was 12 feet square and 12 or 14 feet deep. It received the discharge from the different closets in the building. All fecal matter went into it. Yet so rapid was the evaporation caused by the great chimney which had its lower opening in this vault, that the residuum, after weeks of unremoved deposit, was a *dry inodorous powder*, upon which one could step as upon a dusty road.

Again, in the city of Laramie, Wyoming Ter., as I noticed on a more recent visit to that place, the refuse from the houses and stables is thrown into the alleys and seldom removed. Yet so rapid is the evaporation in that dry and breezy climate, that one can at all times walk through these alleys "dry shod."

Rapid evaporation is a notable peculiarity of a very dry climate. The same result would be reached by the operation of a large chimney, such as I have described. It would be an effectual desiccant for a sewer vault.

As Dr. Sloane says: "When the aqueous portions of sewage are disposed of, nine-tenths of the problem is solved."

This simple appliance of a heated chimney exhausting a sewer vault would, I think, be found sufficient and effectual for "small systems," for farm houses, for large hotels used as summer resorts, for localities where no drainage is possible, for buildings that are almost on a level with tide water.

GEO. W. DU BOIS.

Hartford, Conn.

Gravity at Different Heights.

At a recent meeting of the Berlin Physical Society, Dr. Thiessen gave an account of experiments which he had carried out in order to measure the amount by which gravity varies at different heights. The method he employed was that of Jolly, but with the introduction of a modification, in order to eliminate the irregularities due to differences of temperature at the higher and lower stations. Scale pans were attached to each arm of the balance—one close up to the beam, the other some distance below it—and the weight was interchanged between the pans, both at the upper and lower stations, thus eliminating the influence of differences of temperature and of any inequality of the balance. The upward force of the air had no influence on the results, notwithstanding the varying volumes of the weights used. The distance between the upper and lower scale pans was 11·5 meters, and the weight used was 1 kilogramme. Twenty-four determinations were made, which gave as a result that the kilogramme, when in the lower pan, weighed 2·8 milligrammes more than when it was weighed in the upper pan. After making some corrections, and, among these, one necessitated by the fact that the weight in its lower position was 4 meters below the general surface of the earth. it was found that the weight of 1 kilogramme varies by 0·28 milligramme for each 1 meter of difference in altitude.

The United States at the Paris Exhibition.

The United States will make a creditable display at the Paris Exhibition. And this is as it should be; for, although nominally a universal exposition, it will be practically a display of the products of republics. The monarchies of Europe will be represented only by private exhibits, while the republics of North and South America have rallied in force. The United States Department of Agriculture will make a splendid showing. Secretary Colman has placed the undertaking in the hands of Professor C. V. Riley, the famous entomologist, an energetic organizer as well as a careful and enterprising scientific observer; and Professor Riley has already sent forward three car loads of products, which are on the way to France in charge of Mr. F. T. Bickford, an assistant. The bulk of shipments are nearly through with, and the perishable staples will follow during the next month. Congress appropriated $250,000 to aid exhibitors, and Secretary Colman's quota of this will insure the best illustration that the agricultural resources of this country have ever had on the continent of Europe. Various branches will be represented, as follows: Fruit, Professor Van Deman and Professor George Hussman; grain, George N. Hill, St. Paul, Minn.; cotton and fibers, Col. James A. Benford, Duck Hill, Miss., and Charles R. Dodge, Boston; tobacco and peanuts, Alexander McDonald, Virginia; agricultural education and experimental stations, W. O. Atwater, Department of Agriculture; vegetables, including hops, M. G. Kern, St. Louis; entomology, including apiculture and silk culture, C. V. Riley, N. W. McLean, of Hinsdale, Ill., and Philip Walker, Department of Agriculture; sorghum and other sugar plants, H. W. Wiley, Department of Agriculture; forestry, B. Fernow, Department of Agriculture, and M. G. Kern, of St. Louis; grasses and forage plants, George Vasey, Department of Agriculture; meat products, Dr. De Salmon, Department of Agriculture. All articles for exhibition will be forwarded free from New York, and no charge will be made for space in Paris. Professor Riley has put forth unusual exertions to get the exhibit on the road, and he looks forward with much enthusiasm to the result. He will not leave for Paris till the first week in April.—*Science.*

Obscure Dangers of Drinking Water.*

The difficulty of detecting the typhoid germ is so great, owing to its form being like that of many other bacteria, and the number of typhoid germs is so small compared with the volume of water and with the multitude of other bacteria usually present, that the isolation and determination of the existence of this microbe in large bodies of water, by culture investigations and the microscope, has thus far proved practically impossible, on account of the many tests required before a cautious investigator would dare to pronounce large volumes of water free from pathogenic microbes.

Some of the worst forms of disease may be widespread through a community by means of the water supply, as was noticeably the case in Plymouth, Pa., and yet both chemical and biological analysis may fail to discern the particular matter which carries the deadly seeds of epidemic. One of the public water supplies of Plymouth contained a much greater amount of organic matter than the other, but it was the water chemically purest which carried disease and death.

With most waters that are proposed for public supplies, there being as yet no practicable means of saying definitely whether they do or not contain the germs of zymotic disease, all that can be determined with regard to them is, first, whether or not they are so situated with regard to sources of contamination that disease germs are likely to enter the waters, and, second, whether the waters exist under those conditions which are favorable to the multiplication of such pathogenic bacteria as may find their way into them. No waters are absolutely free from danger, but some are far more liable than others to be the carriers of disease.

A water supply commonly free from the specific germs of disease, but having conditions favorable to their development, may, when exposed to contamination, be suddenly invaded by pathogenic bacteria and an epidemic produced. When chemical analysis shows a water to contain excessive quantity of putrescible nitrogenous matter according to accepted chemical standards, such water is objectionable on the ground that this matter may afford the pabulum essential to bacterial development. In the presence of (local) putrefaction, spores are often found in great numbers, even when the general body of the water does not appear impure by chemical tests. For this reason, the occurrence in a stream, or body of still water, of limited localities, where quantities of organic matter accumulate and putrefy, may create hot beds for the propagation of bacteria, whose myriads of spores may be diffused through great volumes of water of high chemical purity, possibly contaminating the whole mass. The general body of water may not contain sufficient food or be of proper temperature itself to cause the development of the spores or seeds, but if there are pathogenic germs among them, they will develop when drunk by susceptible persons, and become active agents of disease.

* Report by Jas. T. Gardiner, in the *Sanitary Era.*

A Deep Artesian Well.

The deepest artesian well in the world is now claimed as supplying the baths at Pesth in Austria-Hungary. It is said to be 8,140 feet deep and supplies 176,000 gallons daily at a temperature of 158° Fah.

This temperature does not indicate that all the water comes from the full depth of the well; as the average assigned increase in temperature from observations in deep wells and mines has been found to be 1° Fah. for each 60 feet in depth below the plane of stationary temperature, which in the temperate zone is between 50 and 80 feet, the variation being probably due to variation in the annual mean surface temperature and the conductivity of the rocks beneath. The increase of 1° Fah. in 60 feet would indicate a temperature of 185° Fah. at a depth of 8,140 feet, while an increase of 1° in 54 feet, as found in some other deep borings, would indicate a temperature of 200° at the bottom of this well, thus showing in all probability that the flow of the well is made up of inflowing streams at various depths. The boring for hot water for heating purposes, as has been lately suggested, would be subject to the influx of mid-streams, which, if shut off by piping, would largely diminish the supply, and thus limit the scheme for tapping the subterranean heat of the earth.

The Corrosion of Steel Ships.

An alarming illustration of the facility with which steel corrodes under certain conditions, the *Engineer* says, has been just supplied at Portsmouth. H. M. S. Nile was launched at Pembroke on the 27th of March last, since which time, as there is no dock accommodation at the Welsh yard, she had been afloat in her launching trim without there being any opportunity afforded of examining and protecting the under-water parts of the hull. When she was placed in No. 13 dock at Portsmouth for the purpose of removing the launching gear and changing her temporary propellers, it was discovered that the red lead with which her bottom was coated had extensively peeled off, and that serious corrosion of the plating all along the water line on both sides had taken place. The starboard side amidships is very much pitted, though, as a rule, the pitting and scoring are tolerably uniform. The rivet heads are greatly corroded, and in many instances they appear to be completely eaten away.

Wyandot Cave and its Wonders.

By the invitation of the Long Island Historical Society, of Brooklyn, N. Y., a highly original and unique lecture was delivered in their hall last Tuesday evening by Rev. H. C. Hovey, D.D., of Bridgeport, Conn., concerning the marvelous and picturesque features of Wyandot Cave. The hall was crowded, and the audience expressed great pleasure at the entertainment given. Dr. Hovey was the first writer to bring the Indiana caverns into general notice, through the New York *Tribune*, the *Century Magazine*, and other periodicals, as well as by various papers read before scientific societies. A few years ago he took with him a skillful artist, who made a large number of sketches, some of which were afterward published. But during the last year a young artist, Mr. Ben Hains, has taken for Dr. Hovey's use a series of admirable photographs, which were exhibited for the first time in connection with this lecture. Besides the series from Wyandot Cave, there were some lovely scenes from Marengo and Sibert's Caves. These are pronounced the very best specimens of subterranean photography yet produced.

Prizes for Scientific Works.

The Royal Academy of Sciences of Turin, in accordance with the last will and testament of Dr. Cesare Alessandro Bressa, and in conformity with the programme published Dec. 7, 1876, announces that the term for competition for scientific works and discoveries made in the four previous years, 1885–88, to which only Italian authors and inventors were entitled, was closed on December 31, 1888. The Academy now gives notice that from January 1, 1889, the new term for competition for the seventh Bressa prize has begun, to which, according to the testator's will, scientific men and inventors of all nations will be admitted. A prize will, therefore, be given to the scientific author or inventor, whatever be his nationality, who, during the years 1889–90, "according to the judgment of the Royal Academy of Sciences of Turin, shall have made the most important and useful discovery or published the most valuable work on physical and experimental science, natural history, mathematics, chemistry, physiology, and pathology, as well as geology, history, geography, and statistics." The term will be closed at the end of December, 1890. The value of the prize amounts to 12,000 Italian lire ($2,500). The prize will in no case be given to any of the national members of the Academy of Turin, resident or non-resident.

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A MACHINE TO SUPERSEDE TYPESETTING.

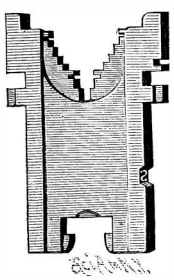
(*Continued from first page.*)

the copyholder is a series of vertical tubes, one to correspond with each key, forming the magazine in which the matrices representing type are held. The keys are pivoted in a supporting frame carried by a bar attached to the magazine tubes, and each has a vertical slot or opening for the passage of a matrix, which drops by gravity as the key is depressed, another type at the same time descending from the magazine tube to take the place of the one discharged, and bearing upon the

TYPE BAR.

upper edge of the key. This slotted oscillating key thus serves as an escapement, receiving the matrices one at a time from the tube, and delivering them through the corresponding openings beneath, the delivery being instantaneous as the operator touches each key.

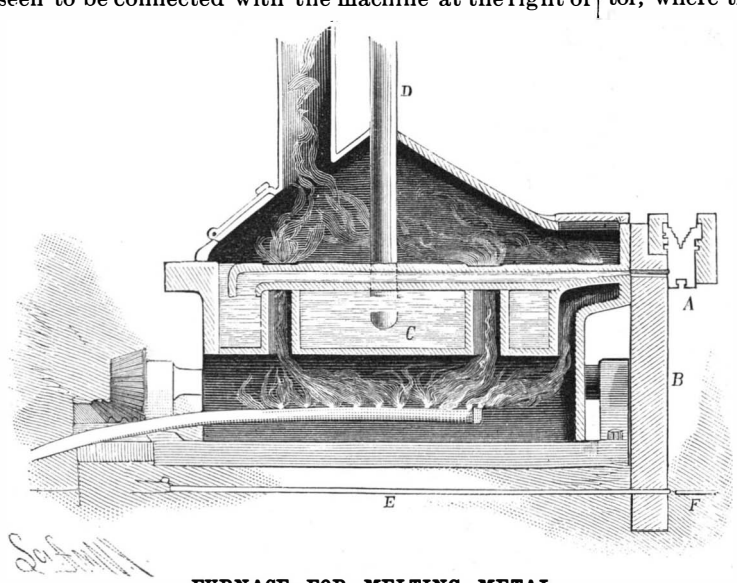
The matrices, of which one is shown herewith, each consist of a thin plate of brass, an inch and a quarter long, about three-fourths of an inch wide, and of a thickness minutely defined by that of the letter produced on each, all matrices bearing the same letter being exact duplicates of each other. Each matrix has suspending shoulders differing on the matrices representing the respective characters, and secondary shoulders or notches differing in width on the different matrices, these special distinctions being necessary to insure the correct automatic distribution of the matrices to the magazine tubes after they have been used. A side view of one of the matrices is also shown at A, in the sectional figure, where it forms part of a line as held up for casting.



MATRIX.

The magazine in which these matrices are held is composed of a series of independent vertical tubes, each internally of suitable size to receive its particular matrix, and drawn from sheet metal, to make a smooth, seamless, and perfectly true conductor, through which the matrix will pass without danger of stoppage. The upper end of each tube is slightly enlarged or flared, to permit the free entry of the matrices, and any tube can be removed independently of the others.

To receive the matrices, as they are delivered one at a time below the magazine, and conduct them to the point at which they are assembled or composed to form lines, a horizontal guide or channel is provided, with rails on which the shoulders of the matrices are supported, the matrices fitting loosely in such channel, and being maintained therein in substantially upright position. The matrices are advanced through this guide or channel to the point of assemblage by means of a blast of air directed longitudinally through the channel, from the lowermost of the two tubes seen to be connected with the machine at the right of



FURNACE FOR MELTING METAL.

the operator, the other tube being connected with the casting mechanism, to assist in cooling the mould. By this means the delivery of each matrix is effected so promptly that its motion can hardly be seen, the click of the matrix coming to its place in the line being formed seeming to be almost simultaneous with the touching of each key, little fingers or followers at the same time continually pushing forward the characters until the line is completed, or approximately so.

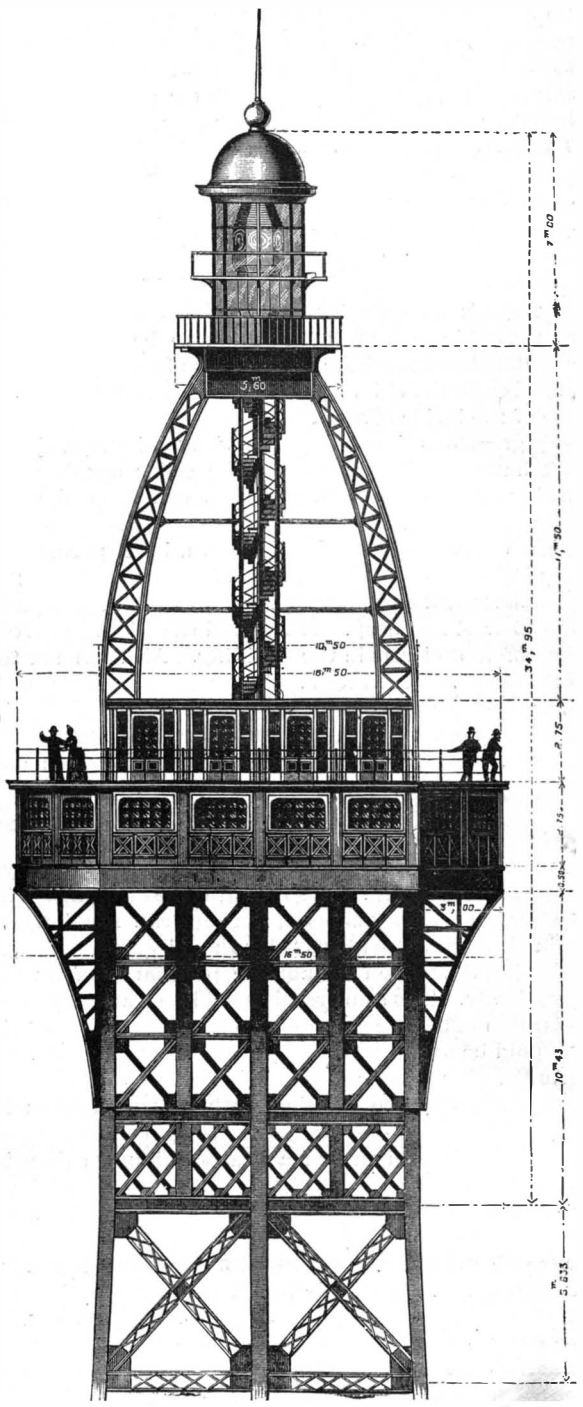
This brings us to one of the most interesting features of the machine, that of the justification of the lines, the difficulty of mechanically effecting which has heretofore been one of the principal obstacles in all such machines. In this machine the operation is simple, the justification is perfect, and takes no time. The matrices, as they are pneumatically delivered and loosely held in horizontal position on their guides, have their sides in which the letters are cut plainly in view of the operator, who can then replace any letter which may have been erroneously used, and also see when his line is so nearly full that it will not hold another word, or whether some word possibly had better be divided, or how much more space will be needed to make the line full, according to the predetermined measurement. The usual spaces between the words, etc., as ordinarily inserted by the compositor, are already in place, having been inserted in the same way as the matrices, by the use of a "space key," but the spaces here used differ from the matrices, and consist of longitudinally tapered or wedge-shaped bars, three or four inches long, with their larger ends hanging down below the bottoms of the line of matrices. These space bars now do all the further work of spacing, being caused to rise automatically by means of a vertically reciprocating plate acting against their lower ends, until the line has been expanded to the full limits allowed by the clamps which determine its length. In this way the increased space between the words is evenly divided, and "uneven spacing" is simply impossible, no attention to the matter being required on the part of the operator, who is already touching the keys for the formation of the next line.

The line of matrices thus completed is received by a head opposite the end of the stationary type guide, there being immediately below and behind the head a mould, in the form of a vertical disk, having a mould chamber or slot extended horizontally through it of a form and size identical with that of the required type bar. This portion of the machine will be better understood by reference to the sectional view, where B represents the disk mould, A the line of matrices as held up thereto, C the reservoir of melted metal in its gas-heated chamber, D a plunger acting as a force pump to force the metal into the mould, and E an ejector bar which has forced out the type bar, F. For the purpose of forcing the line of matrices tightly against the mould, their characters registering with the mould proper, an outside clamping head is employed to bear against the outer edge of the line, while supplemental clamps or jaws assist to hold the line firmly and in exact adjustment. To avoid overheating of the mould when rapidly operated, it is made with transverse openings adapted for communication with the blast nozzle, although no difficulty is ordinarily experienced on this account.

There are, as is well known, a great variety of type metals, according to the sizes of type and its uses, ordinary type for newspaper work being mainly composed or 6 parts lead and 2 of antimony. The addition of a little bismuth, however, carries down the melting point, and also produces a softer metal, as more commonly used for stereotypes. Such an alloy, composed of 9 parts lead, 2 of antimony, and 2 of bismuth, readily melts at about or a little over 300° F. The thin type bar made by the machine, therefore, readily cools sufficiently for ejection during the revolution of the mould disk, the type bars being thence carried to a galley attached to the machine just to the left of the operator, where the bars are assembled in the order of their production in the form of a column ready for immediate use.

Not only is all this work done automatically, but the matrices, after the type bar has been formed, are automatically withdrawn from their position against the mould disk and lifted by a carrier to the distributing mechanism, at the top of the magazine, whence they are distributed to their several tubes. This distributing mechanism consists essentially of an endless chain or belt, arranged to travel horizontally above distributing rails, the belt carrying a series of blocks armed with adjustable forks or fingers to act between the matrices and push them forward. The rails are parallel and sufficiently separated to admit of the matrices being carried in an upright position between them, and the inner edge of each rail has a lip designed to engage the shoulders of the matrices and hold them in suspension, the lip being divided transversely into a number of sections to engage matrices having different shoulders, whereby each matrix will be sustained upon the rails until it is carried to the point at which it is to be released to drop into its proper tube in the magazine. Connected with the distributing rails are wires from a battery, by means of which a matrix forced or dropping out of place will cause the closing of a circuit and the stoppage of the carrier belt; the particular matrix causing the stoppage is always immediately in front of the operator, with whom it is only the work of a moment to replace the matrix, or remove it entirely if it happens to be defective.

How far this machine may be considered a practical success for general uses, in the way of superseding typesetting by hand in the old way, it is perhaps too early to give a definite answer. It is obvious that it is not adapted for work requiring different varieties of type, as small capitals, italics, accented letters, etc., although we understand the machine is now being made to use small capitals as well as the other characters usually employed in Roman text. But there is a large class of work, especially that required for newspapers in general, in regard to which this objection would not be very material. The actual performance of the machine at present, and for many months past, on such plain work, is about equal to that of three ordinary compositors, and it requires but a short time for an operator to attain an efficiency which will enable him steadily to maintain this speed, as compared with hand work. This, at least, has been the experience on the New York *Tribune*, where only thirty machines are ordinarily kept running for a day's work of eight hours each to get out a ten-page edition of the daily, which would require the services of about ninety men



THE TOP OF THE EIFFEL TOWER.

[FOR DESCRIPTION SEE PAGE 152.]

in the old way of working. The absolute saving of all distribution, which is equivalent to about one-quarter of the work of composition, is of itself a most important factor in the economy of the machine, while "standing matter," in the form of these type bars, can be kept for an unlimited time, and in any amount, without inconveniencing the office. To correct an error a new line has to be made, but this is done so quickly that the entire work of correcting is said not to be increased. When a considerable number of the machines are employed, the more or less constant services of a machinist or repairer would undoubtedly be necessary, but the machine, as it is, appears to be a wonderfully perfect piece of mechanism, almost endowed with intelligence, and we are informed that one machinist easily does all the repairing needed on the forty machines now in use in the *Tribune* office. The machines are not for sale, as we understand, so that the question of their cost cannot be answered, but they are to be leased, those using them to pay a fixed sum on the execution of the lease and a quarterly rent besides.

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AUTOMATIC INDICATOR FOR MAGAZINE GUNS.

Mr. Wm. R. Miller, No. 30 Hopkins Place, Baltimore, Md., has invented an attachment for repeating guns and rifles, having an automatic adjustment for indicating at any time the condition of the magazine as regards the number of cartridges contained therein. None of the repeating firearms as now offered to the public, whether Winchester, Colt's, Marlin, Spencer, Bullard, or Hotchkiss, has any device for registering the number of cartridges contained in the gun.

The automatic register, which has been patented in this country and abroad, consists of a small brass cylinder placed within the magazine of the rifle. The magazine spring is in two unequal lengths, instead of in one piece, as usual, the small cylinder referred to being placed between these two sections. The cylinder is of brass, having a star or indicating mark placed upon it, and sliding within the magazine. There is a slot or opening near the end of the magazine, and the star or mark on the sliding cylinder will appear through this opening, indicating the number of charges in the magazine. When the magazine is filled with cartridges and the springs are compressed, the cylinder is forced toward the outer end of the magazine. As each cartridge is discharged the cylinder or indicator moves toward the stock of the gun a distance which bears the same proportion to the length of a cartridge as the length of the short spring does to that of both springs. The shape of the opening makes it unnecessary to have either numerals or graduating marks stamped on the magazine of the rifles, the star at the first notch showing the magazine is about one-fourth full, at the second notch that it is half full, and so on. This construction, as will be seen by reference to the different figures, is applicable to all the usual forms of magazine rifles.

Figs. 1 and 2 represent either a Winchester, Marlin, or Bullard repeating rifle, with indicator. In this representation the magazine has an additional sleeve or cover on the outside, which can be slipped over the slot in the magazine and entirely conceal the indicator whenever desirable, while in Fig. 5 the indicator is shown in one of Colt's new lightning magazine rifles, and has no outside sleeve.

Fig. 3 represents magazine, showing the indicating cylinder.

Fig. 4, section of cylinder, showing springs.

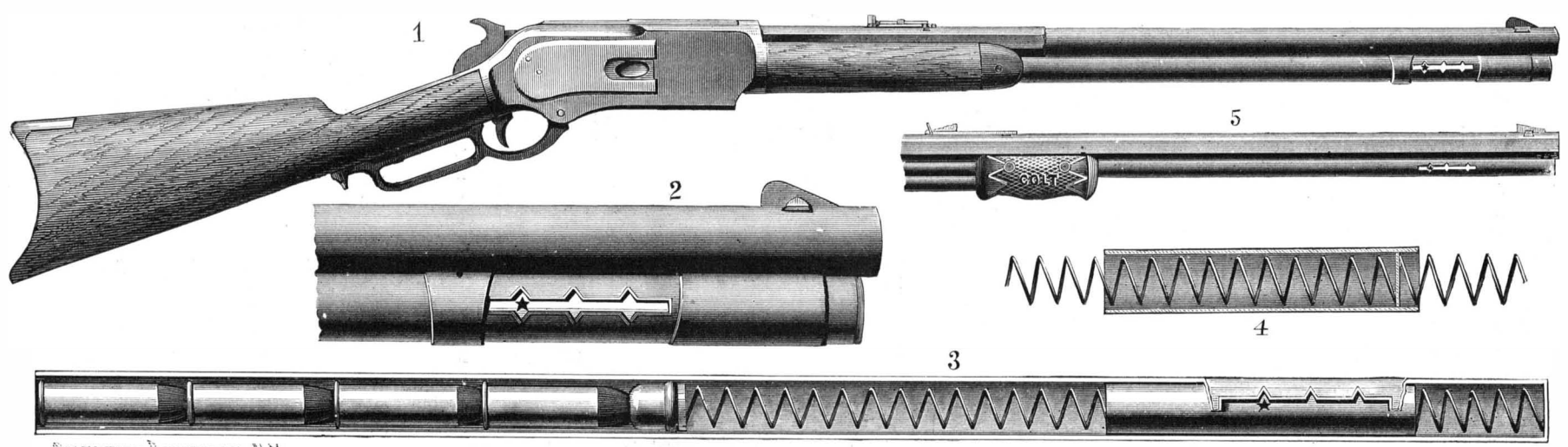
In repeating shot guns the manner of registering is somewhat different, numerals being engraved or stamped on the cylinder. These numbers are observed through a small round opening in the magazine (see Fig. 6). In general, it may be said that the two springs are so proportioned that a movement of the length of a cartridge—say two inches—at one end of the magazine gives the cylinder the desired movement of from one-eighth to one-sixteenth of an inch. The opening in the magazine is always covered internally by the small brass cylinder working within, so that no part of the spring or interior of the magazine is exposed.

Fig. 6 represents repeating shot gun with indicator. Fig. 7, magazine and indicator. Fig. 8, enlarged view of indicator. Fig. 9, breech of shot gun, showing improved double-hold hammer, specially intended for semi-hammerless guns, by the same inventor.

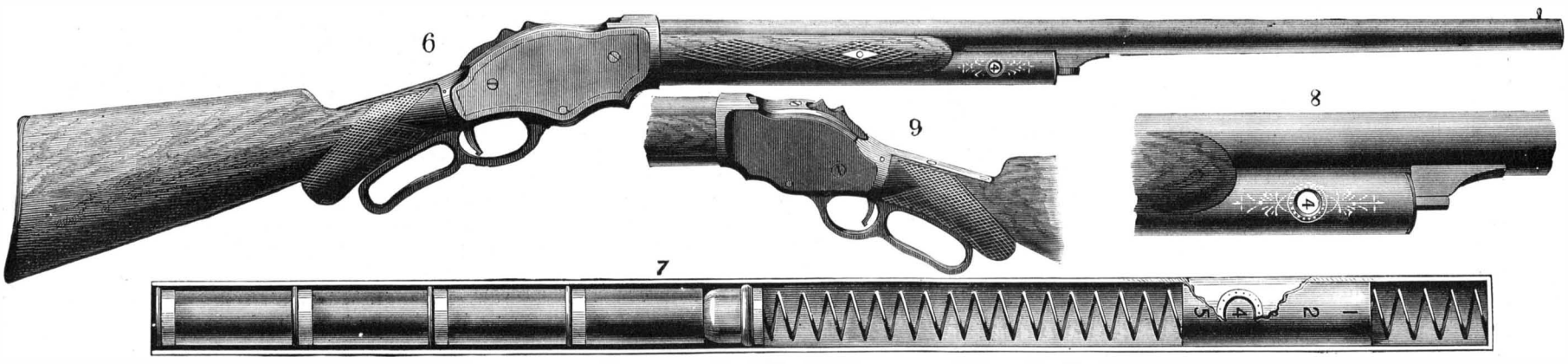
The indicating device illustrated in this article is new, simple, and inexpensive, and when in use will remove one of the grave objections to this class of arm, namely, the total inability of the user of repeating guns to know or even approximate the contents of the magazine without actually emptying out all the cartridges, counting them and then reloading the magazine as at first.

One of the special advantages of this indicator is that, while it can be made as a part of the arm, it can also be made as a separate piece. It will be put upon the market as an indicating magazine, and will be so constructed that it will interchange with the magazine of any of the guns that it is arranged for, which will allow the indicator to be put upon the many rifles now in use, the purchaser of an indicating magazine removing the regular one from the gun and putting the new one in its place.

For further information regarding this invention, address Mr. Miller, at Baltimore.



AUTOMATIC INDICATOR FOR MAGAZINE RIFLES.



AUTOMATIC INDICATOR FOR MAGAZINE SHOT GUNS.

The Real Value of Money.

Did you ever consider this subject? There is some philosophy in the hard-hearted answer which a Boston millionaire is said to have made to a request from a lady of that city, who had appealed to him in behalf of a charity. "Madam," said he, "I would be glad to help you, but I am utterly unable to do so at this moment. Why, madam, I have to-day one million and a quarter of money in the banks, and, believe me, this amount is not yielding me one cent of interest."

Money has both an intrinsic and an earning value. If you have a dollar in the morning, and at night find that it has cost you just that dollar to get through the day, you have only realized its intrinsic value; but suppose that, by a judicious investment, you find at night that you have been able to pay your day's expenses, and still have a dollar left from that investment, you realize something of its earning value. If that investment in the morning yielded you not only the dollar back, but seven cents in addition, and after paying the expenses of the day you found that you had the dollar left, the earning value of that one dollar was just seven cents, no more, no less. And so in the transactions of the year, if an investment be made at the beginning, and at the close, after deducting every expense of any kind or nature, including natural wear and tear, it be ascertained that the original amount is unimpaired, the earning value of that original investment may be summed up in the amount used to pay the above mentioned expenses. If a surplus remain, then the investment has increased in value; if a deficit exist, then the original investment is impaired.

Taking these propositions as truths, then, it may be assumed with safety, that the first object of importance, in any trade or occupation, is to preserve one's capital unimpaired. It is very clear that, when one's capital is exhausted, one's occupation is destroyed. A second is to so manage an investment as to establish, if possible, a surplus, as a rear guard, if you please, to the original capital. The value of this original capital will thus be increased, and if there be a demand for it, it is then possible to spread out one's business, being ever mindful that whatever amount is set aside as a working capital, the first object of success is in preserving it intact.

Bearing these things in mind, it will not be difficult in any enterprise to determine whether prosperity or the reverse has attended one's energies. This principle holds true throughout every sphere of life's work. Take, for instance, any one of the various trades. Consider the time and money expended in learning a trade; then one is only realizing the intrinsic value of money. But suppose after years of constant practice and endeavor, the apprentice becomes a skilled artisan, and just before he starts out in his life's work, he takes account of the money it has cost him and of the time, reduced to a money basis, he has spent in his apprenticeship, and sets that down as his capital, if he is then able to make for himself a comfortable living, and in time is able to lay up for future development, he is reenforcing very substantially the capital which he invested in his early training. He is realizing the earning value of his money. Otherwise he knows only of and has exhausted its intrinsic value. The true value of money, therefore, may be said to be measured by the benefits which may arise from a judicious investment thereof for a stated time, and without its impairment in any particular.

In this connection the *American Artisan*, from whom we copy, relates an instance taken from an English journal quoting from a chapter in the life of one of the greatest metallurgical and engineering kings of this century, as follows: "He made it a rule for many years to utilize his profits in the extension of his works." "This," says this English journal, "is the secret of building up a works from nothing, till the output, after twenty-five years, reached over $20,000,000 annually. Such are the colossal enterprises of William Baird & Co., Krupp, Stewarts, Crossley Bros., and hundreds of others that will occur to the reader at once."

Dangers of Tree Sawing.

In California the saw has largely supplanted the ax in bringing down redwoods, but the change is severe upon the woodsmen. After being sawed partly through, a tree is forced over by inserting a number of steel wedges in the kerf, which are driven in with steel sledges. They are set in as close together as possible, and the driving of the wedges frequently requires three hours or more. The constant contact of the steel sledges with the steel wedges results in chipping off fragments which fly with great force, and in numerous instances become embedded in the flesh of the workmen, requiring surgical operations to remove them. Many eyes have been lost in this way, while arm and shoulder wounds are frequent. Some means of protection against the sharp missile is needed.—*Northwestern Lumberman.*

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LANTERN PANTOGRAPHS.

BY GEO. M. HOPKINS.

For the production of off-hand tracings for illustrations, especially during the projection of a series of experiments or pictures, nothing can excel a pantograph adapted to the lantern. Two forms are here shown, both of which produce figures on the prepared glass without exhibiting the arm by which the work is done.

The instrument shown in Fig. 1 is, perhaps, hardly deserving of the name given to it, as it is not strictly designed for accurate copying, on account of distortion, but it may be used in copying when a true figure is not important. It is designed rather for tracing upon the prepared glass while the operator watches the progress of his work as it is projected upon the screen.

The base board is provided with a square central opening, having around it a rabbet for receiving the prepared glass. This board is adapted to the lantern, and furnished with a pair of small buttons for engaging diagonally opposite corners of the prepared glass and holding it in place. The tracing arm consists of a square metallic frame, *a*, containing a glass plate, and having at one edge an arm carrying a tracing point, and provided at the opposite edge with two parallel rods arranged to slide freely through a block, *b*, pivoted to the base board. The center of the glass in the frame, *a*, is perforated to receive a needle, *c*, which is pressed forward toward the prepared glass by a small spiral spring, as shown in the sectional view. The needle thus supported may be moved around upon the prepared glass in any required direction, and it may be readily lifted from the plate by pulling the tracing point away from the base board.

By placing a design upon the board, it may be traced and reproduced upon the screen, and, if the designs are specially made so as to compensate for distortion, correct tracings will be produced.

By means of the pantograph shown in Fig. 2, anything, large or small, may be readily and correctly traced. The levers are arranged relatively, so as to produce upon the prepared glass a tracing one-third of the size of the original. With this pantograph, writing, figures, maps, diagrams, sketches, etc., can be made with great facility.

The base board of this instrument is necessarily somewhat cumbersome, as provision must be made for the supports of the pivot of the pantograph, for the prepared glass, and for the design to be traced or a sheet of paper on which to mark. The base board is adjustable up and down on a slotted standard, and the latter is provided with a foot, which permits of clamping it to the table.

The metallic frame, *a*, which is attached to the arm, *b*, contains a transparent plate of glass, having a central perforation, in which is inserted a stout sewing needle—a small carpet needle, for example. The bar, *b*, is pivoted to one end of the short metallic bar, *c*, and the opposite end of this bar, *c*, is pivoted on a stud projecting from the rock shaft, *d*, which can turn in supports attached to the base board. Upon the same stud is pivoted a bar, *b'*, which extends parallel with the bar, *b*, and both these bars are pivotally connected with the bar, *c'*. The lower end of the bar, *c'*, is provided with a tracing point, *f*, for which a lead pencil may be substituted when an original design is to be made. The paper on which the design is drawn is attached by drawing tacks to the lower part of the base board. The rock shaft, *d*, is provided with a long key, *e*, which extends downward, and is pressed outwardly by a spring underneath it. The key is prolonged above the rock shaft, where it is provided with a screw for limiting the motion of the key and shaft. The arrangement of the shaft and key is shown in the small detail view.

The shorter arms of the levers of the system are 4 in. long, and the longer arms are 12 in. long. That is to say, when the bars are at right angles to each other, the distance between the bars, *b b'*, is 4 in., the distance between the bars, *c c'*, is 12 in., the distance from the tracing needle at the center of the transparent

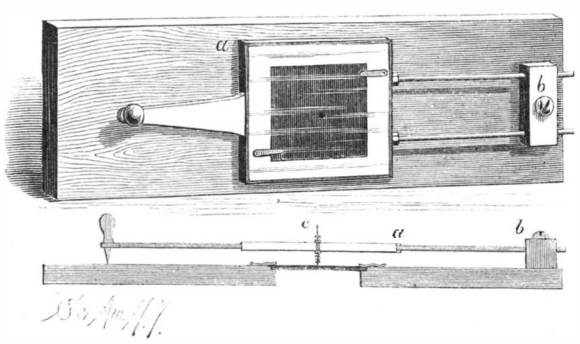


Fig. 1.—SIMPLE TRACER FOR THE LANTERN.

glass to the pivotal connection of the bars, *b c*, is 4 in., and the length of the bar, *c'*, from the pivotal connection of the bar, *b'*, to the tracing point, *f*, is 12 in.

The glass plate on which the tracing is made is preferably coated with collodion colored with aniline. If this is not convenient, the glass may be smoked.

The needle is prevented from touching the prepared glass by pressing upon the key, *e*, thus slightly twisting the entire system. When the point of starting is reached, the key, *e*, is released, when the spring under the key, through the key, rock shaft, and bar, *c*, carries the frame, *a*, forward, and brings the tracing needle into contact with the prepared glass, when the tracing begins. When it is desired to interrupt the line, the key, *e*, is again depressed, when the needle may be moved to a new position without making a mark.

THE TOP OF THE EIFFEL TOWER.

The top or "crown" of the Eiffel tower of 300 meters, or 984 feet, is represented in the engraving on page 150, which, to a considerable extent, explains itself.

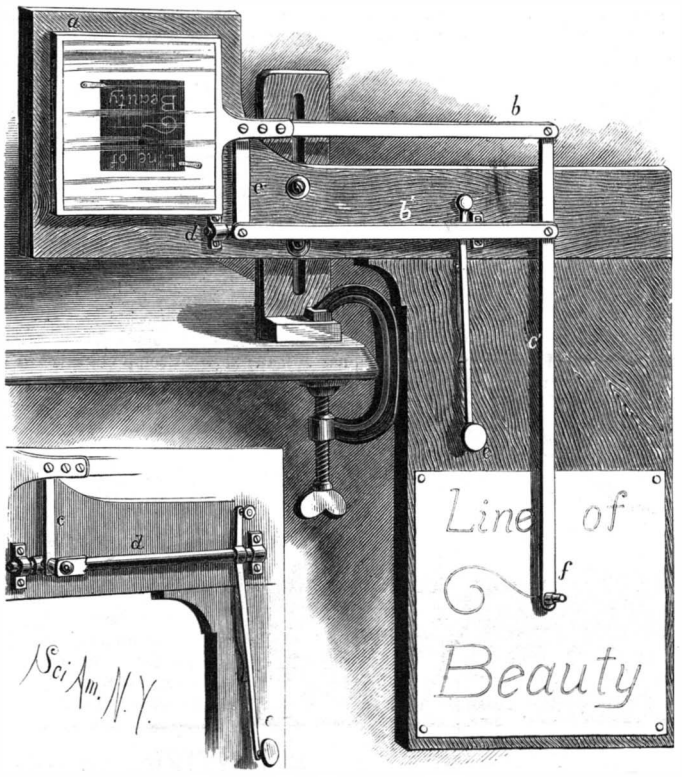


Fig. 2.—LANTERN PANTOGRAPH.

The lowest platform therein represented is the third one from the surface of the ground, and is 276·13 meters above the bottom of the four feet of the tower. This platform includes the balcony of square form, measuring 17·50 meters on each side. The outside promenade will be of glass plates in movable frames. In the center of the platform, on a surface 10·50 meters square, will be a kind of cabin, divided into laboratories for experiments and places for observation. Above this set of cabinets will be another set divided into little apartments.

The highest platform of the tower, which will be 293 meters above the ground, is accessible by a little spiral staircase, with an iron-plated newel. The diameter of this platform is 5·5 meters. It has four trellis supports of curved form situated at the diagonals of the rectangles formed by the main supports of the tower.

The summit of the tower consists of a lantern 7 meters high, which will contain an optical system the same as that of a lighthouse of the first class. The diameter of the lantern will be 3·5 meters, with a path round it. The light will be a fixed one, but means will be provided to enable it to project rays of blue, red, and other colors. In addition, two optical projectors will be provided, giving the power of illuminating at will the principal monuments of Paris or points of interest in the neighborhood of the city.

The question of the possible use of the Eiffel tower for scientific purposes has been often raised, and as yet we have seen no authoritative document on that head signed by any scientific man or indorsed by any learned society, but scientific utility is possibly a secondary object in its construction. The tower will be such a curiosity in itself as to powerfully help to draw many visitors to Paris during the exhibition. On the first of January a book on the Eiffel tower, by M. Max de Nansouty, engineer, was published in Paris, and the author gives the names of several leading French men of science who have expressed "approbation;" but approbation of what, is not quite distinctly stated. The author then suggests that the tower may prove useful for strategical observations in case of war, as the movements of the enemy can be watched when sixty kilometers or more away, as far as the most powerful forts for the defense of Paris. If Paris should be surrounded, signals could be flashed from the top of the tower to friends outside the lines of the enemy, and secret messages given to them optically by a cryptographic method. Possibly, says our author, the enemy might fire howitzers at the tower, although he would have difficulty in bringing them to bear, despite the progress of modern artillery; but then each projectile would have no more effect on the tower than a little grain of lead thrown against the web of a spider—some bars of iron will be broken and quickly repaired, and that will be all.

The foregoing cheerful ideas of M. De Nansouty are suggestive of an anecdote about the Duke of Wellington. The latter was said to hate being pestered by inventors, but, nevertheless, one wormed his way into the Duke's presence, while he was busy writing, and said that he had invented and brought with him a suit of armor which was ball proof. "Put it on," said the Duke, as he resumed his writing. When the inventor had donned his armor the Duke instructed an officer in the room to order a file of soldiers into the courtyard, and, said he, "Tell them to load with ball." He once more resumed his writing, and when he looked up again the inventor had disappeared, armor and all. If ever an enemy should be firing with heavy guns at the Eiffel tower, it is to be hoped that M. Max de Nansouty will be placed in charge of the signaling department at the top of the edifice.

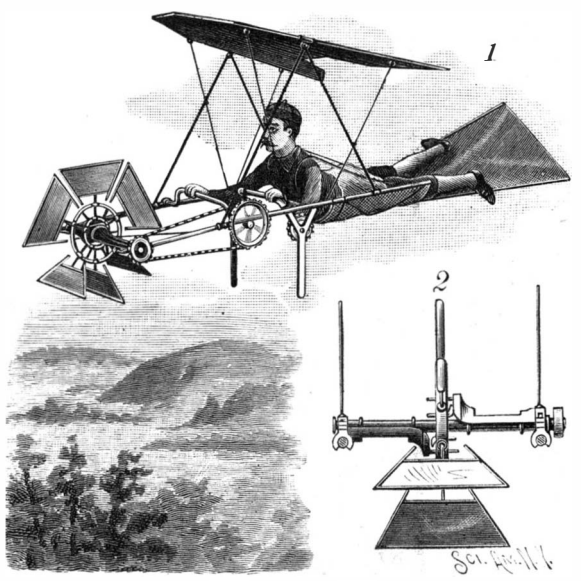
The same author says that the tower will be useful for astronomical observations, being above the level of many ground fogs. To some extent this is no doubt true, for although high towers are of no use for astronomical telescopes, because of the vibration, it is conceivable, for instance, that observations by the naked eye of flights of meteors could be better made from the top of the tower than from the bottom.

M. De Nansouty states that the tower will serve the purpose of supporting electric lamps at great heights. This is unquestionable.

Our author says that the tower will give the means of indicating the time to places at considerable distances. For the first time, except from the unstable car of a balloon, man will have at his command a vertical height of 300 meters, and can then study the fall of bodies through air, the resistance of the air at different velocities, certain laws of elasticity, the compression of gases and vapors, the oscillation of the pendulum, and so on.—*The Engineer.*

AN IMPROVED AIR SHIP.

A light and strong machine for navigating the air, designed to be readily controlled by the aeronaut to give the best results in flight with the least expenditure of power, is illustrated herewith, and has been patented by Mr. John P. Holmes, of Oak Valley, Kansas. The horizontal frame of the machine is suspended by hanger bars or rods from an aero-plane, which is a rod frame covered on one face by a silken fabric. Toward its rear there is attached to the side bars of the horizontal frame a canvas forming a rest or support on which the aeronaut will lie, face downward, on his breast and stomach, so that his hands may conveniently reach two transverse cranked shafts, by working one of which he can alter the incline or pitch of the aero-plane, while with the other he can rotate a propeller wheel journaled at the front of the machine. At the rear is a rudder sail, on the sides of which lie sacks to receive the legs of the aeronaut, and allow him to guide the machine by his legs in its flight. The aeroplane is arranged to be rocked up and down, and locked at any desired adjustment, for utilizing wind currents and the propelling force of the wind to the best advantage. Fig. 2 is a front view of the propeller wheel, which is operated by a chain belt from the cranked shaft in front of the aeronaut. The hub of the propeller is fixed to a tubular shaft journaled in boxes formed at the end parts of sleeve cams and in half boxes held to the opposite side bars of the frame, to cause feathering of the blades, so that they will be held edgewise to the wind during their passage through



HOLMES' AIR SHIP.

the air above the level of the propeller shaft, and will turn their blades flatwise to the wind during their passage around below the level of the shaft, this construction and action of the propeller assuring its maximum lifting and propelling power to raise and urge the air ship forward.

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RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR COUPLING. — Ephraim H. B. Knowlton, Watertown, Dakota Ter. This invention covers a novel construction and arrangement of parts in which the drawheads are counterparts of each other, and each also provided with the ordinary coupling link and pin, the coupling hook provided by the invention being fitted to have a vertical movement on a pivotal pin.

RAILWAY CAR. — William L. Covel, Biloxi, Miss. The car or locomotive has at its end a three-sided platform, one side formed in line with the car body and the other side inclined to the direction of motion, so that cars or locomotives meeting will be directed off to opposite sides of the track, and the cars will be prevented from telescoping.

RAILWAY. — Robert P. Faddis, New Mexico Ter. According to this invention the rail seats are held in a crib frame, anchor rods being passed through openings in and secured to the base of the rail at opposite sides, and extended and secured to the lower portion of the crib frame, with other novel features, increasing the solidity and firmness of the construction.

TRACK CLEANER.—Augustus F. Priest, Fort William, Ontario, Canada. This device is made with two knives hanging on bolts so that the lower edges of the knife bars are about on a level with the bottom of the nose of the pilot of the locomotive, and adapted to clear the track entirely across between the rails, the apparatus being supported upon the pilot and forward truck in such way as to be readily raised by the engineer.

Mechanical.

LOOM.—John L. Aldinger, Syracuse, N. Y. This invention covers a warp tension regulating device for looms, specially adapted for wire looms, and by which the warp beam or drum is dispensed with, the warp threads being run from the spool to the harness, while at the same time the necessary tension is given to the warp threads or wires.

PRINTING MACHINE.—Henry H. Harrison, New York City. This invention covers a novel combination and arrangement of parts designed to provide a machine for printing cards, circulars, or other small matter, upon one side of the paper only, and cut the paper into sheets as rapidly as printed, the paper being printed from a continuous ribbon upon a drum.

WINDMILL. — Franklin B. Kendall, Turnwater, Washington Ter. Rods are connected with the spokes of the windwheel and with a sliding rod operating on a drum carrying the vane, with other novel features, whereby the windwheel is turned out of the wind automatically as soon as the wind blows with more than normal pressure.

DIAMOND CUTTING TOOLS. — Hugo Keller, New York City. The method of securing diamonds in the tools is covered by this invention, a longitudinal recess being provided in the cutting edge of the teeth for the insertion of the diamonds, which are held in place by a clamping plate riveted or brazed on, brazing material being used to fill up any spaces in the diamond socket, so that when the tool becomes worn the diamonds may be readily removed.

Agricultural.

CORN HARVESTER.—James McKivett, Garrison, Iowa. This is a machine designed to cut corn, whether it is planted in rows or not, as the machine is driven across a field, in the same manner as mower or reaper is driven through grass or grain, the machine also removing the husks, the latter remaining on the stalks, cleaning the husked ears, and delivering them into a bag or a wagon traveling beside the machine.

HAY STACKER.—Jesse Morris, Sioux Rapids, Iowa. This is a machine in which the fork is operated by ropes passing over pulleys at the top of inclined beams and thence under pulleys located near the bottom of the main frame, the hay being deposited upon the tines of the fork, and the ropes then drawn upon by a horse hitched thereto.

DIVIDER SHOE. — Charles W. Love, Fairpoint, Ohio. This invention covers an improvement in outer divider shoes for the cutters of mowers and reapers, to so construct the seat for the finger bar that the seat may be readily trimmed out to fit any of the ordinary finger bars now in use, the invention also embracing other novel features.

CULTIVATOR AND HARROW.—Thomas E. Carter, Augusta, Kansas. In this machine the cultivator teeth are so fixed as to effectually cultivate the ground adjacent to the corn, while a series of harrows may be projected from the body of the cultivator proper, the harrows being adjustable, and there being at the rear of the frame scrapers adapted to convey the loose dirt into the roots of the corn.

Miscellaneous.

HOT AIR FURNACE. — Benjamin F. Price, Bloomington, Ill. This furnace has a conical inner casing, bottom casing, and upright outer casing forming an inclosed air space, in combination with a dome, tube plate with short tubes, and other novel features, designed to secure perfect combustion of the fuel and thorough utilization of the hot air.

STEAM HEATER.—Daniel D. G. Langlands and Otis E. Moulton, Dover, N. H. The boiler of this heater has a large heating surface, large steam space, and comparatively small water space, and is not liable to become water-logged, the apparatus being adapted to be readily introduced into or incorporated with any casing.

GRAIN WEIGHER. — William H. H. Brunton, Elk City, Kansas. This invention covers various novel details and combinations in a machine designed to automatically measure and register the quantities of grain delivered by an elevator connected with a thrashing machine or grain bin.

GAS MANUFACTURE.—John C. Garvin and Henry Moody, Leadville, Col. This invention covers a novel construction and combination of parts for manufacturing gas from hydrocarbon and other liquids, such as oils of various kinds, and for cleaning the retorts and pipes used without disturbing them, the liquids being decomposed and converted into gas by being brought into contact with suitably heated surfaces.

SAW.—George H. Holmes, Ogdensburg, N. Y. This is a band saw for cutting wood, having an annealed back and the rest of the blade and cutting edge tempered with the ordinary temper of wood saws, the back of the blade being thin and the rest of it of even thickness, making a saw designed to work smoothly without being liable to crack or break.

WIRE TIGHTENER.—Louis S. Flatau, Pittsburg, Texas. This tightener is more especially designed for use in taking up the slack in wire fences, the frame having guides for the wire and a threaded bearing in which turns a screw with a hook to engage the wire, there being a shackle for keying the hook to the screw, the device being also capable of use in tying packages with wire and for other purposes.

THILL COUPLING.—Isaac Clark, Morris Plains, N. J. This coupling is adapted for use in connection with an ordinary clip, bolt, and nuts, the invention covering novel details of construction and arrangement of parts designed to afford a coupling that is simple, strong, and convenient in use, while being easy to couple and uncouple.

TRICYCLE. — Patrick Gallagher, New York City. This invention covers an improvement on a former patented invention of the same inventor, a fly wheel being applied to the driving mechanism and a brake capable of application to the driving wheels, whereby the operator can readily regulate the speed of the vehicle without changing his position on the seat.

HAT MARK.—Henry H. Wright, Paola, Kansas. This is a device, the use of which is designed to prevent parties taking the wrong hat, and consists of a frame adapted to be secured to the inside of the hat with a name-plate hinged on the frame and locked in place thereon by a pin, the device being adapted to be held permanently on the inside surface of the hat.

SUSPENDER BUCKLE.—James England, New York City. This buckle has a base plate with outwardly extending ears in which a bar is journaled having a longitudinal row of teeth, with one or more of the teeth in the row inclined at a different angle from the others, but so that both rows of teeth may be moved out of contact with the web.

BOTTLE FAUCET.—Felix Stefany, New York City. This faucet has two valves operated independently of each other, one serving to open or close the inlet and outlet pipe and the other adapted to open or close a vent, the device being specially designed for conveniently filling a bottle with a liquid under pressure, and for sealing the liquid in the bottle and discharging the contents as required.

CAN FASTENER.—Calvin Keeler and Harvey Lewis, Hobart, N. Y. This fastener consists of a grooved casting in which is fitted a sliding hook adapted to engage the wired rim of a can, a cam lever being pivoted in the casting and arranged to bring the hook into engagement with the wired ring, the device being especially adapted for use with milk cans.

MATCH BOX AND CANE.—Simon B. Simon, New York City. This is a box for use in connection with canes, umbrellas, and similar articles, and is made with a sliding lid, of such form that it will not readily open when the cane or umbrella is carried.

THEATRICAL APPLIANCE. — Fred Wilson, New York City. This invention combines with a stage a mechanical structure representing the interior of adjoining compartments, a chair having a balanced pivoted body with electric lamps sunk therein, and connected with electrical apparatus in the adjoining room, affording convenient means for flashing light and manipulating the chair.

AUTOMATIC ALARM. — Emil Meyer, Ottleben, Prussia, Germany. This invention provides an apparatus whereby watchmen, firemen, etc., may be reminded of recurring times to give attention to particular duties in connection with furnaces and other matters, and whereby, in the event of failure, an alarm bell will be rung, the latter to be connected, if desired, with an alarm bell in the office of the superintendent or manager.

SEWING MACHINE.—William C. Foster, Jersey City, N. J. This is a machine for forming a double row seam, or "whip stitch," wherein the side loops are bound at the lock formed by the chain stitch, the invention consisting principally of a hook and means for reciprocating it, whereby each side loop or stitch is shifted laterally to have the chain stitch loop thrust through it.

STITCHING FABRICS.—William C. Foster, Jersey City, N. J. This invention covers the method of stitching by the above machine, consisting of passing two loops through the fabric, a short distance apart, one to be formed into a chain stitch and the other into a transverse loop, the latter occupying a position between the chain stitch loops and the fabric.

PIANO KEY BOARD. — Enoch L. S. Osborn, Waxahachie, Texas. This key board has all the keys of uniform size and color, a sliding attachment being arranged above the keys with stripes to represent the usual white and black keys, the keys also having numerals and letters forming guides for the adjustment of the sliding attachment, whereby the scale may be transposed, the invention being intended to facilitate teaching.

SHADE FOR BURNERS. — James and William J. Stratton, Brooklyn, N. Y. The shade is formed with an elliptical top, and has a funnel-shaped ray conductor, a wire coil or ring carried by the shade being adapted to receive a burner tip, the construction being such that the flame will not impinge against the shade when the burner is inclined from the vertical position.

MUSIC OR BOOK HOLDER. — Herbert O. Brown, Auckland, New Zealand. This holder has an attaching portion with spring arms to engage a shelf, a finger being pivoted at the outer ends of the attaching portion to swing at right angles to the spring arms, and having on its lower end a weight.

CHIMNEY COWL.—David Teets, New York City. In this cowl a series of vertical equidistant strips separated by slots are combined with a series of semi-cylindrical plates arranged vertically, covering the slots and serving as smoke conductors, making a ventilator cowl designed to promote draught and avoid down draught.

VEHICLE SPRING.—James F. Thomas, Alexandria, Neb. This is a novel form of side spring, the springs being bowed at their centers, with means for securing them at their central portion to the framework of the vehicle, whereby they are restrained from torsion at their centers when the load is on, the invention being an improvement on a former patented invention of the same inventor.

SAW.—Nicholas Petry, Rockport, Mo. This is a device for sawing tenons and gains and to save the time and labor of measuring them, the heads or holders of the frame having slits in which saws are adjustably held, so that one saw can be dropped below the other, to permit cutting of tenons having one side longer than the other, or both saws can be lowered, when the frame will form a gauge.

HAY PRESS.—Michael McCarty, Montrose, Col. This press has combined with it a horse power mechanism for operating the plunger, and the hay or material to be compressed is fed in batches to the press box, where it is compressed by the reciprocating motion of the plunger, being compressed at each forward motion and pressed out of the opposite end of the press chamber.

WATER CLOSET.—John J. Balls, Jacksonville, Fla. This invention covers a novel construction and combination of parts in water closets of that class in which the bowl is flushed automatically by the action of the movable seat.

WIRE STRETCHER.—George R. Hughes, Savoy, Texas. This device has an essentially T-shaped body, the members of the head having a series of teeth, combined with a pivoted lever and clamping jaws, whereby the device can be readily attached to a post and engaged with the wires to be stretched.

SCIENTIFIC AMERICAN

BUILDING EDITION.

MARCH NUMBER.—(No. 41.)

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References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(411) R. G. D.—The so-called perpetual motions are not perpetual motions in a mechanical sense. They derive their motive power from some change in the physical elements, principally heat. The change of temperature during the day and night may be made to keep a machine or clock constantly running. There is power expended here, no matter if it comes from a natural change of temperature, the blowing of the wind, or falling of water. It is a derivative power, and not the mechanical perpetuity that has crazed too many otherwise good and useful minds. The deep sea soundings are made with a fine steel wire carrying a shot that is detached when it strikes the bottom. The wire is wound on a large reel driven by a steam engine.

(412) A. S. asks: What kind of a battery to use to explode gunpowder, and also how he could make one, and of how many cells it should be? A. Use two or three cells of a plunge battery, such as described in SCIENTIFIC AMERICAN, of December 17 or August 20, 1887. A small length of iron or platinum wire No. 36 must be placed in the circuit embedded in the powder.

(413) F. S. S. asks how to make a battery of sufficient power to run the simple motor? What would such a battery cost? Would it be practical to reduce said motor in all dimensions 50 per cent? Also could you mention a book, of reasonable price, on batteries of different kinds for different uses? A. See

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SCIENTIFIC AMERICAN of August 20 and December 17, 1887, and September 3, 1881, for batteries; for an excellent method of making battery plates consult the SCIENTIFIC AMERICAN of October 27, 1888. The battery would cost from two dollars upward. You can reduce the motor, using wire three or four numbers smaller. For general description of batteries, we refer you to SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 157, 158, and 159.

(414) J. E. A. asks: Are there any locomotives built that are driven by electric motors driven by galvanic batteries? If so, what kind of galvanic battery is used? A. Street cars are driven by electricity, the current being derived from secondary batteries. Generally, each car is self-propelling, and is hardly to be denominated a locomotive. A Daft electric locomotive has been tried on the N. Y. elevated road with success. See SUPPLEMENT, No. 687. Primary batteries are too expensive as a source of energy.

(415) J. D. P. asks how talc can be determined, and if there is any market for same? A. Talc occurs in several forms. As massive rock or steatite, it is used in commerce for grate linings, griddles, and similar uses. The finer varieties are used by India rubber manufacturers, tailors, for marking cloth, paper makers and other trades. Its general appearance, slippery or soap-like surface, and softness enable it to be recognized. It can be scratched easily by the finger nail.

(416) C. F. W. asks: 1. Can I use German silver wire in place of silver wire for the single fluid batteries described in SCIENTIFIC AMERICAN SUPPLEMENT, No. 157? A. German silver will answer for sulphuric acid solution, but will give inferior results. 2. What kind of batteries would be better for a small electric light, the plunge batteries or the single fluid batteries as named above? A. Use a good sized Bunsen or plunge battery.

(417) P. D. H. writes: 1. I have a quantity of battery cells, and wish to construct glass covers to prevent evaporation. Can you tell me how to proceed to make a hole through the covers to hold the carbons and zinc plates? A. Select a copper or brass tube of the size the holes are to be. Cement a cork the exact size of the bore of the tube upon the glass plate, where the hole is to be. Secure the tube in a brace, place it over the cork, and feed with emery and water, and turn it. The glass must rest very solidly upon a good surface. The tube will soon cut a hole through it. 2. Has the motor described in SUPPLEMENT, No. 641, a reversible motion? A. None has been arranged for it yet. You can do it by shifting the brushes, but you should have an extra set faced the reverse way. 3. Will ammonia evaporate when subjected to heat, or rather what is the effect when boiled? Does it lose its chemical properties? What are the chemical changes? A. Ammonia evaporates when heated; there is no chemical change, unless we consider that when an aqueous solution is heated, the molecules of ammonic hydrate (NH_4 OH) are broken up into ammoniacal gas (NH_3) and water (H_2O). 4. Is there any known formula for regenerating carbons—after being depolarized in use in a sal ammoniac battery—to make them fit for use again? A. Let them stand, or heat them in an oven. 5. Which of cast iron or wrought iron is the best electrical conductor? A. Wrought iron.

(418) D. F. H. writes: What causes the singing of the telegraph wires? Here on the prairies it is sometimes almost defeaning. A. The wind sets them in vibration on the principle of the Æolian harp. They really form an immense harp of this character.

(419) A. G. asks for the best method for making a permanent magnet—shape, temper, and steel? A. Use chrome steel or other good quality of tool steel, drawn to a straw color. Surround it with a coil of insulated wire and pass a strong current of electricity through the wire. This will magnetize it. The shape may be what is known as horseshoe or bar. You will find magnets described in our SUPPLEMENT, Nos. 2, 218, 302, and 318, which we can send you by mail for 10 cents each.

(420) E. P. B. writes: I have a circular glass plate (common window glass), diameter 2 ft. 4 in. I intended to use it for one of the wheels of a Holtz electrical machine, but dropped my plan because I could not get a hole (for the axle) through the center of it. Wearing it with sand takes too long. A glass cutter refused to take the risk, and acids are too expensive. Please let me know several good ways which will accomplish the result, *i. e*, put the hole through center. A. You can drill the hole with a copper tube. See answer to query 417. Experiment on several pieces of glass before you try it on your disk. The glass must be very solidly supported from below. For directions for mounting a plate, with or without drilling a hole in it, consult Bottone, Electrical Instrument Making, pp. 30–36, which we can send you by mail for $1.20.

(421) B. D., Jr., asks: How much of the wire used in making the electric motor should be insulated? A. All the wire should be varnished, and if cotton wound also, the motor will be more efficient.

(422) F. S. writes: 1. Will you kindly inform me through the columns of your valuable paper, the SCIENTIFIC AMERICAN, of which I am a subscriber, which is the heaviest, salt (sea) water or fresh? both being the same temperature, and if there is a difference, what is the cause? A. There is a difference in the gravity or weight of salt and fresh water, due to the weight of the salt held in solution. For sea water, this amounts to $\frac{22}{1000}$ in excess of the weight of an equal volume of fresh pure water. 2. My parents are both German, but I am American born. Am I an American or German-American? A. You are legally an American citizen, but in speaking of your descent, the expression "German-American" is customary and proper.

(423) R. Williams writes: Can you give all the reactions in the preparation and use of a Plante storage battery? A. The lead in the forming process is converted at the one pole into binoxide at the expense of the oxygen of the water molecule by the action of the current (*a*). Then the direction is reversed, and the other plate is oxidized, while the binoxide of lead is reduced to the metallic state (*b*). When ready for action, one electrode is coated with binoxide of lead and the other with spongy lead. When the circuit is completed, the spongy lead takes up oxygen from the water, becoming protoxide (*c*). The hydrogen that goes to the other pole takes up oxygen and reduces the binoxide of lead to the form also of protoxide (*d*). While this is going on, the sulphuric acid in the cell combines with the protoxide of lead, forming plumbic sulphate at both poles (*e*). In the charging process this acid is set free, the sulphate of lead by the electrolytic process being converted into metallic lead on the positive electrode (*f*), and into binoxide of lead on the other plate (*g*). The sulphuric acid thus set free increases the specific gravity of the solution, so that by observation, with a hydrometer it can be determined when the battery is charged. When the lead is completely reduced on one pole, gas is evolved, and this also is an indicator of complete charging. The reactions alluded to above by letter are:

(*a*) $Pb+2H_2O$	$=PbO_2+4H$	forming.
(*b*) PbO_2+Pb	$=Pb+PbO_2$	
(*c*) $Pb+H_2O$	$=PbO+2H$	
(*d*) $2H+PbO_2$	$=H_2O+PbO$	discharging.
(*e*) $PbO+H_2SO_4$	$=PbSO_4+H_2O$	
(*f*) $PbSO_4+H_2O$	$=Pb+H_2SO_4+O$	charging.
(*g*) $PbSO_4+O+H_2O=PbO_2+H_2SO_4$		

(424) W. S. P. asks (1) the formula for carbonated glycerine, an explosive used in shooting gas wells. A. For high explosives see SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 674, 627, 552, 406, also a complete work on modern explosives and their use, by Eisler, $4.00, which we can mail. 2. The formula for a white fire suitable to burn in a closed room, and made by dipping sheets of paper in some preparation which is dried and when used the paper is fired. A. Dip in gum water, dust over with magnesium powder and dry. See Techno-Chemical Receipt Book, $2, on explosive agents. 3. The directions for making a megascope, an instrument for throwing an enlarged picture of opaque objects or wood cuts upon a screen. What kind of lenses, the size and length of focus, the focus or curvature of the reflector, and distance from lenses, and the angles of the picture to the lenses and reflector and position of the light? A. For a megascope: Plano-convex lenses of 2, 3 or 4 inches in diameter may be used. The focus may be four times the diameter, set with convex sides toward each other, and ¾ their diameter apart. The general arrangement will be seen in the description of an electric megascope in SCIENTIFIC AMERICAN SUPPLEMENT, No. 640. The reflector may be a little larger than the lenses, of from 3 to 5 inch focus, set behind the light at a distance that the reflected image of the light may just cover the picture, the light being placed at one side, or if two lights are used, then one on each side of the field of the lenses, so that no light will interfere by passing out directly through the lenses.

(425) L. F. writes: 1. I wish to light four rooms of a house with incandescent lights. I wish to run them with a battery. How many cells will it take? What will be the cost to run it by the hour? What will be the probable cost of the lamps, batteries, etc.? A. Your lamps, wire, and general connections will cost about $25. The battery will cost $50 to $100. You will need twenty to thirty cells for each lamp that is run simultaneously with the others. For each lamp allow an expense of 2 to 5 cents an hour. 2. Please give a receipt for the article called sea foam, used by the barbers on the hair. A. Try the following formula:

New England rum	1 pint.
Bay rum	¾ "
Glycerine	2 oz.
Carbonate of ammonia	1 "
Borax	2 "

3. How to make a (cotton) web razor strap? A. Rub the surface with a mixture of washed emery and lard. 4. Also a leather strap. A. Use Russia leather or the skin from a horse's tail. No preparation is needed.

(426) L. E. F. writes: 1. Can you inform me of an economical process of making a good and cheap carbon for Grenet batteries? A. For an admirable method of making carbons from electric light pencils, we refer you to the SCIENTIFIC AMERICAN of October 27, 1888. 2. Also if the current developed by the telephone generator is continuous or otherwise, and what the strength of it is? A. It alternates in direction, and presumably stops for an infinitesimal period as the direction changes. Its strength is exceedingly slight. Mr. W. H. Preece has lately determined that a Bell telephone will respond to a current represented by 6×10^{-13} ampere, or 0·000,000,000,000,6 ampere. One gramme degree of energy would suffice to make a telephone continuously sound for 10,000 years.

(427) G. J. S. writes: 1. What is understood by the technical term or word *volt*, and how applicable in electrical science? A. Volt means the inducing cause of an electrical current, bearing the same relation to electricity that "pounds pressure per inch" do to steam or "head" does to water. One cell of gravity or Daniell's battery gives about 1·07 volts potential. 2. What is understood by the technical term or word *ohm*? A. The unit of resistance offered by a wire or other conductor to the passage of an electric current; 1,000 feet No. 10 pure copper wire represent a little over one ohm. 3. What is the difference between a primary and a secondary current in telephoning? A. The secondary current is an induced current derived from the secondary circuit of an induction coil. 4. What is a storage battery? A. Many are described in our SUPPLEMENTS. Generally speaking, it is a battery that is brought into the active state by the passage through it of an electric current from a dynamo or primary battery.

(428) J. G. asks: 1. What is the value and weight of a cubic inch of pure gold? A. A cubic inch of gold bullion weighs 0·6965 troy pound, and at its present price, $20.66 per troy ounce, is valued at $230.23. 2. Value and weight of a cubic inch of pure silver. A. A cubic inch of silver bullion weighs 0·3788 troy pound, and at its present price of 98 cents per troy ounce, is valued at $5.89. 3. What kind of a small crucible is best to melt these metals in, and can they be melted in a charcoal fire with the aid of bellows? If not, how can they be melted without the aid of a furnace? A. Use the ordinary Hessian or sand crucibles, which may be obtained through the hardware trade, for melting gold and silver, or the black lead crucible, which is safer from breakage. A charcoal fire in a cylinder, with small bellows, or an ordinary cylinder stove with a good draught, are suitable for melting small quantities of gold and silver.

(429) C. A. F. writes: A client of mine is building an apartment house 120 feet by 140 feet, six stories high, in the central portion of this city. He has drilled an artesian well which brings the water within 35 feet of the top of the ground; the well is 223 feet deep, 35 feet being limestone rock, 125 feet white sandstone, the balance very hard limestone. There will be a tank 123 feet from water level at the top of the building. Now the questions are: Where would be the best location for the pump—at the water level, or on top of the ground? How many gallons of water would be needed for say 250 people, hot water, steam for elevators, etc., including provision in case of fire? The well is supposed to have a capacity of 400 gallons per minute. How can we test it? Give the name of a good manufacturer of force pumps. We would like to get at their capacity of gallons per minute. Will the sand rock give way and disintegrate when the pump is at work and the water agitated? Would it not be better to pipe it? Does the water in an artesian well fluctuate, or remain about a normal height? A. The supply of water in various towns for family use, fire and other purposes has a large range in the United States, running as low as 30 gallons per capita in small towns to as much as 100 gallons or more in large towns, or where the sources of supply are abundant. Probably for the above building a daily supply of 50 gallons per capita will be in excess of all demands. This will be 12,500 gallons per day, which should be pumped within 10 working hours, or at the rate of 21 gallons per minute. This will require a vertical deep well steam pump equal to double the required supply, with extra long stroke. The pump bucket should work in the lower end of a tube at about 100 feet down to insure a flow of water at the rate of pumping. This is the cheapest way to test the capacity of the well, for as you have the pump of sufficient size, you have only to lengthen the pipe and rod, if the pump draws the water below the bucket without giving the required quantity. The length of the pump pipe should be so proportioned as to be equal to more than the whole supply required, including the lowering of the water level, or say 200 feet. The pump should be located just above the top of the well. You will require no tubing for the well, as the water probably comes from the sand rock. There are causes that will make the static level of the water in the well fluctuate through the seasons. Address the Deane Steam Pump Company, New York, and American Well Works, Aurora, Ill., for artesian well pumps.

(430) A. D. asks how much pressure there is to the inch in a rifle of 45 caliber, using 75 grains powder and 350 grains lead, and twenty-eight inch barrel. A. The explosive pressure in a rifle is from 30,000 to 40,000 pounds per square inch, according to the quality of the powder and the proportions of weight of powder and ball. 2. And also how much more the pressure is behind the bullet than it is in the front of it after leaving the shell? A. The pressure in front of the bullet increases as it moves toward the end of the barrel, but is only a very small percentage of the pressure behind. 3. When will a wagon run easiest—if the most of the load is put on the hind or on the front wheels? Who can take the biggest load—a good horse weighing 1,500 pounds or a good ox of the same weight? A. Most of the load should be placed on the hind wheels for easiest hauling. A horse can pull a heavier load than an ox of the same weight.

(431) C. F. M. writes: Some time since there appeared at my place of business here, a party engaged in the nickel plating of cutlery, whose claim to the above mentioned mode of plating I think was unfounded, the coating appearing to me to savor more of galvanizing. As an adjunct he had an iron pot in which it appeared he melted zinc, solder or spelter, after which the blades of the knives or forks were put into some sort of acid solution, allowed to stand for the space of possibly 15 minutes before being subjected to the substance melted. Upon removing the articles from the pot containing the melted substance, he put them in some kind of oil, after which they were rubbed dry. Will you kindly inform me through the columns of your issue as to the ingredients that were employed to produce the results attained? I forgot to mention that after the knives were withdrawn from the supposed acid solution, a kind of powder was put into the pot for the purpose, I suppose, of clarifying it. Now, what was the kind of powder used and the substances placed in the melting pot? A. We presume that the knives were plunged in a bath of metallic tin, and that the powder was sal ammoniac. They were not nickel plated, in any sense. The acid may have been muriatic acid; the oil may have been cotton seed oil, or lard oil; the metal may have been block tin or possibly solder. We doubt if it was spelter.

(432) J. H. B. writes: I wish to construct a dry pile. The books say cover a sheet of porous paper on one side with tin foil, on the other with a paste made of powdered peroxide of manganese, etc., cut into disks one inch in diameter, etc., and place in a glass tube. 1. How much of an interval is required for the electricity to acquire sufficient tension to pass through the paper, etc.? A. An hour or more may be required to recuperate the pile after exhaustion. 2. Can a dry pile be constructed that will give a continuous current? A. Through high resistance it will do this when constructed as described. 3. What will be the effect of dampening the pile? The books say such a pile lasts for two or three years as to current and durability. A. Dampening will tend to destroy its action by short circuiting. 4. Can you indicate what the tension would be of such a pile, of say 500 elements? Would it give a slight shock to the nerves? A. Perhaps 100 volts. It will probably affect the nerves a little.

(433) C. A. Y. writes: In this neighborhood is a well which exhibits a peculiar phenomenon. It is on the side of a west slope, about 100 yards from a small creek and is 30 feet in depth. Apparently it is not connected with the creek, as it is not affected in the least by rains, nor have I ever noticed any current of air flowing either in or out of the well. But in the winter ice forms at the bottom sufficiently thick to resist the hardest blows of a heavy well bucket, while between this well and the creek is another well 20 feet deep, the water of which shows scarcely any difference of temperature during the year. This is the only instance of the kind in this country, to my knowledge. Is it a common occurrence or not, and is there any known cause? A. The water in the water-bearing strata where wells are sunk is supposed to be always moving toward a lower level at a rate corresponding to the declivity of the strata and coarseness of the sand. In wells where this movement is large the water is always sweet by circulation and not liable to freeze in coldest weather. In wells that happen to be located in a sluggish current, or in a pocket that only draws its supply scantily from every direction, there is more liability to become foul in summer and to freeze during the coldest weather. Such wells require frequent cleaning. It is the circulation of the cold air by gravity in contact with the still water that causes freezing.

(434) D. E. writes: Will you tell what sizes of wire to use to wind the simple electric motor, so as to use the Edison current instead of battery? Also you say in one number that it would double the power to increase the lineal dimensions one-half. Does that mean to make the spool three inches long instead of two and of no larger diameter? A. Connect it in shunt on the Edison circuit. Increase all lineal dimensions in same ratio, make the spool half larger diameter, etc.

(435) E. W. W. writes: Can I use Leclanche cells for lighting a one-candle Edison lamp for periods of from five to ten seconds, three or four times in twenty-four hours? If so, how many cells will it require? A. They are well adapted for this use. You will need five cells.

(436) A. P. G. asks: What is the process for printing from plate engravings, that is a flat copper plate engraved backward? Is a common letter press used for it? A. A roller press is used. The plate is inked and the smooth surface is wiped clean, the engraved lines retaining the ink. The paper and plate are then passed between the rollers of the press, when the ink is transferred to the paper.

(437) P. Van S. asks how the solution of annatto is made and what from. A. It is extracted from the outer part of the seed of *Bixa orellana*, an evergreen, a native of Brazil. Alcohol may be used for its solution.

(438) A. G. writes: I would like to know how to color a meerschaum pipe or cigar holder so that it will be black as ebony, without smoking it? A. Try aniline blacks, or logwood extract in water, followed by treatment with a solution of copperas.

(439) F. B. writes: In edition No. 3, vol. 60, I see question No. 161, F. B. C. asks: Could I charge storage battery of one cell, with static electricity generated by a belt? You answer him, practically, no. What is the matter with using an old incandescent lamp or other form of Leyden jar as a discharger grounding through an inverted induction coil or transformer? (Please remember I am only asking a question.) The static discharges being always in one direction, would the low potential discharges be in one direction also, or would there be two impulses, due first to magnetizing, and a second to demagnetizing? If the static electricity from the many belts of large mills could be used this way, would it not be of some use? A. The method seems impracticable, as there is but little electricity given off by a belt, and when reduced in potential it would be hardly perceptible. The induced discharges would be in two directions. If the belts produced any quantity of electricity, they would run stiff in proportion to the electric energy developed. You cannot get something out of nothing.

(440) D. O. B. writes: What power is required for an eight-light dynamo, and is there a small engine built that would run the dynamo mentioned? A. You need about one horse power. For addresses of engine builders, consult our advertising columns.

(441) H. & R. ask: Cannot a high grade of steel be told by the color and the grain? Are they not evidences of high grade and fine quality? Also, is not a fine quality of steel susceptible to taking and holding temper, as a coarse or loose grained steel is not. Our remarks are in connection with cutlery steel? A. Much information as to the quality or grade of steel can be had directly from observation of the grain by fracture and its ease of breaking. The fineness of the crystalline surface and its color, as well as its toughness in breaking, are the leading points of observation with buyers of steel at first sight. Its qualities in hardening are the final test, and require much care, as most grades of steel require special manipulation in amount of heat and manner of hardening and tempering for various kinds of tools. The finer crystallization is generally preferred for high duty tools. Cutlery steel requires elasticity, and is generally made from the lower grades, which have special names, as double shear, shear, or spring steel. These have a coarser grain than the fine tool steels. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 505, for an interesting article on steel.

(442) S. P. F. asks about a wheel revolving along the ground. (Plane surface.) 1. Does the wheel revolve around its center or not? If not, why? A. Every revolving body has a center of revolution. The center is not a revolving body, but is an imaginary axis occupying a neutral point within the forces generated by revolution. 2. Does centrifugal force act with equal intensity on all points equidistant from the center of the wheel, or not? A. Yes; in a perfectly balanced wheel, in which the materals contributing to centrifugal force are equally distributed throughout the mass. 3. Are not the top and bottom of the revolving wheel the extremities of an infinite number of straight lines drawn through its center perpendicular to the infinite number of points of contact with the ground, in other words, a line parallel to the surface along which the wheel is revolving? A. Yes. 4. Does the top of the wheel revolve with greater velocity than the bottom, or than any other point equidistant from the center? A. The top and bottom of a wheel rolling along a straight surface move in a straight line, yet the wheel revolves around a common axis. The top and bottom of a rolling wheel move only as fast as the axis. The peripheral velocity at the top of the wheel is twice as

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great as the rectilinear velocity of the axis. The periphery does not move at the bottom. All parts of the periphery move with equal velocity around the axis.

(443) M. A. P. asks (1) how to make paste such as bookbinders use. Do they use glue or flour paste? A. Ordinary flour paste is generally used, though sometimes a little glue is added to make the paste tougher. Some antiseptic, such as carbolic acid or alum water, is added to prevent souring. 2. How engravings are made by the process known as "zinc etching." Is it the same as producing engravings from zinc plates by the action of acids? A. The process is the same in principle, but in the ordinary "process" plates, for printing with types in a form, the blacks are in relief and the whites sunken, while in an etched plate the whites are in relief and the blacks sunken, the printing then being done as that of a steel engraving. Nitric and muriatic acids, of various degrees of strength, are used in each case to bite out the metal. 3. Where can the zinc plates be procured, and what are their cost? A. Most large electrotyping establishments could furnish them to order. They are not on sale by dealers, and are specially prepared of soft zinc, with a surface as smooth as glass, by an expert in this line. 4. Would like a short description of how electrotyping and stereotyping are done. A. For electrotyping, the type form is well brushed over with plumbago—a wax mould is then taken, and a thin electro deposit of copper made therein. This thin deposit of copper is stripped off and baked with type metal flowed on. For stereotyping a plaster cast is made of the face of the type to form a mould—or the mould may be made of a kind of papier mache substance beaten into the face of the form. The face moulds so made are placed in another mould or form to give the proper body or backing and receive the melted type metal.

(444) D. T. E.—Printers' rollers are not usually made with India rubber, except such as are used on newspaper presses maintaining a high rate of speed. For ordinarily fast presses on book work the following is a good composition: 10½ lb. best glue, 2½ gals. black molasses or honey, 2 oz. Venice turpentine, 12 oz. glycerine. The quantities of glue and molasses will be slightly varied according to the season, comparatively more glue being used in summer than in winter. If French glue is used, it will be necessary to let it soak overnight to take up the right quantity of water, but most domestic glue will take up sufficient water in about two hours. The turpentine and glycerine should be added and well mixed with the composition just before pouring. When rubber is used to make the black composition described in the SCIENTIFIC AMERICAN of January 12, the rubber should be cut in fine shreds and dissolved in benzine, ether, or bisulphide of carbon, *not* in alcohol. It should be mixed with the turpentine and added to the composition the last thing before pouring, the glycerine and vinegar being mixed with the glue and molasses a short time earlier, after the latter has become well combined in a kettle in a water bath over the fire or in a steam-jacketed kettle.

Enquiries to be Answered.

The following enquiries have been sent in by some of our subscribers, and doubtless others of our readers will take pleasure in answering them. The *number* of the enquiry should head the reply.

(445) M. E. G.—Please state why throwing salt upon a fire will put out a burning chimney? Also please state how the magicians do the trick of raising tables, chairs, etc., by simply laying their hands upon them? This is an old performance, and is now being done by Kellar.

(446) H. B. H. writes: Will you please advise us of the mixture used for coating iron so as to give it the dull black finish seen in chandeliers and andirons? It is called Berlin black, and will not rub off.

Replies to Enquiries.

The following replies relate to enquiries recently published in SCIENTIFIC AMERICAN, and to the numbers therein given:

(20) Halifax.—Relief Maps.—Although not sure of the method used in Germany, there is one way which, although it involves considerable expenditure of time and materials, produces a map in relief which is extremely accurate and would command extensive orders were the work carefully and accurately performed. Suppose you have a map of a section of country on which are marked contour lines made by passing horizontal planes at vertical distances of ten feet, or any other distance. Take sheets of cardboard so that the thickness shall represent one foot, then ten superposed will give ten feet. The thickness of the cardboard is of course the unit of your scale, both vertical and horizontal. Now cut out pieces of cardboard of the same size and shape of the horizontal space embraced by the different contour lines. Then on your map draw in between the contour lines and approximately parallel to them nine other lines, and cut pieces of cardboard corresponding to them. Superpose these in their regular order, and you have the rough formation in relief of your map. The pieces of cardboard are pasted together and carefully pressed to keep the whole mass uniform. Then smear wax over the whole, in order to make a smooth surface. Different colors will represent roads, grass, rivers, etc. Trees or forests can be represented by dried green moss. Houses and other buildings and constructions are made of wax. In the practical work of making such a map, other details may come up, but they will generally be such as will present little difficulty to any one at all conversant with modeling. The chief difficulty lies in procuring maps with contour lines marked on them.—S. R., Jr.

(245) C. T. I.—Battery Zincs.—The writer has had very good results from zinc plates, built up from thin sheet zinc (stove zinc, the only zinc to be had at the time). These plates were built up by folding over and over and hammering down the fold each time, so as to produce a compact plate of the size required. Building up by cutting several pieces, all to the size required, and then fastening together, was very good, but not so good as the building by folding a long strip. No trouble was had in amalgamating, as the thickness of the plate, after being built up, made it stiff enough to stand well, though the mercury struck clear through each sheet, as was the case. The extreme top of the plate, to which the copper wires were fastened, was not amalgamated, for say a half an inch, to avoid breaking and the brittleness that would have resulted had this end been amalgamated. These plates stood long and severe use, kept their amalgamation perfectly, and consequently never showed any local action. Riveting the plates could not well be done, unless zinc rivets were used. Any other metal would at once make local action from the galvanic couple that would be set up by its presence in the zinc plate, even though it was amalgamated. The four-cell battery mentioned would prove all right if the motor is wound for a low tension current. It would be better yet to use five carbons and four zincs, so as to have a carbon plate for the outside on each side of the cell, and so reduce resistance by having each zinc plate with carbon plate on each side of it. The size of receptacle will, of course, determine whether this can be done or not, and the winding of the motor will determine whether four or eight cells should be used.—C. D. P.

(320) S. L. F.—Stay Bolts.—The pressure or strain upon a stay bolt in series forming squares is the square of the distance multiplied by the pressure on the boiler, or in your case 6 in. × 6 in. × 100 lb. =3,600 pounds strain on the stay. If the areas are not squares, divide the distances between stays and average for the area.

(321) S. H. P.—Propeller.—You will require 65 horse power, besides power required for friction of engine and shaft, and a propeller of four blades, 38 in. in diameter.

(329) D. Y. M.—Softening Water.—See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 629, 270, 187.

(329) How to Soften Water.—If the hardness is due to calcic carbonate, it can be removed by boiling the water. If it is due to calcic sulphate, it can be removed by adding sodic carbonate (common washing soda). In the last case two new substances are formed. One is insoluble and settles, the other is soluble, but does not act on soap.—W. F. W.

(330) S. T. R.—Steam in Boiler Furnaces.—Steam from the boiler or exhaust has been used many years for increasing the intensity of the fire by injecting it under the grate when the draught is otherwise good, or otherwise by using a steam blower which carries a portion of steam under the grates with the air. One of the oldest practices among engineers or firemen is to wet the ashes or throw water on the ash hearth, which evaporates and feeds the fire with moisture. The steam in contact with the hot coal is decomposed, producing carbonic oxide and hydrogen, which are both combustible in contact with air.

(334) W. L. G.—1. Starch granules may be well mounted dry, but best in Canada balsam. If the grains are laid upon the slide, and as small a portion as possible of balsam diluted with turpentine be applied, they will cling to the slide and allow pure balsam to flow over them without making air bubbles. To mount blood corpuscles, cover the slide on the spot required with a coating of blood as thin as possible and allow it to dry. Fasten on cover with a ring of varnish. 2. Raphides are often mounted dry, but are easily mounted in balsam. 3. The highest power of the Lick telescope is about 4,000 diams. For microscopic mounting consult Mr. Davies' useful little book on "The Preparation and Mounting of Microscopic Objects."—Wm. H. P.

(335) L. W. S.—Cyclones.—1. In the first place, do not call them cyclones; that is a misnomer that the public has fallen into, thanks to the daily newspapers. They are *tornadoes*, not cyclones. Cyclones are storms of a very different character. They are like tornadoes only in one respect, namely, they are both rotary storms. The tornado is a funnel-shaped column of disturbed air, generally about forty or fifty yards in diameter, rotating about a nearly perpendicular axis. It forms in the upper air a few miles overhead and works down to the earth. Its track is generally not more than twenty-five miles until it disappears into the upper air from whence it came. They are caused by strata of warm and of cold air struggling against each other. Take, for example, the tornadoes which struck Pittsburg, Reading, and Brooklyn, last January. They were only local incidents of a general storm, the diameter of which was about 500 miles. The center of the storm was between Chicago and Grand Haven, Mich. Draw a circle of 500 miles radius from the general storm center, and you will find that in the southeastern quadrant of that circle tornadoes will form and will move toward some point in the northeastern quadrant. At 8 o'clock A. M. on January 9, there were southerly winds and very high temperature along the south Atlantic coast. In Florida the temperature was over 70°, while in Pennsylvania it was below 30°. The isothermic line for that day bulges up at Chicago and drops violently downward through Pennsylvania and Northern Virginia. The hot air south of the isothermic line was struggling to get northward, and the cold air north of the line was struggling to get south. It was this struggle that caused the tornadoes. Normally the air is much warmer on the earth's surface than it is skyward, but on January 9, if you had gone up in a balloon at Pittsburg, you would have struck warmer air as you went up. The line where the warm and cold air comes into closest contact was the line where the tornadoes formed. 2. There were probably just as many tornadoes then as now. Remember that they are storms of a very limited area, and in a sparsely settled country they would easily escape observation.—H. S. W.

(336) E. W. T.—Gold Lacquer for Tin.—Use thin copal varnish slightly colored with turmeric and bake in an oven. You can buy the varnishes of any required color for stamped tin work from F. W. Devoe & Co., New York.

(364) M. S. O'K.—Stationary Point in Piston Stroke.—The piston stroke of an engine comes to a dead stop at the end of each stroke in theory as well as in practice. So far as visible means can tell it starts immediately on its return stroke, but actually in theory and in practice it stops for a space of time varying, it may be, with the number of strokes per second, friction, etc. The well known formula for space, s, passed over in time, t, in seconds at a velocity, v, feet per second, is $s=vt$, make $v=0$, as it must be at the end of the stroke, and $s=0$, which indicates theoretically a state of rest.—S. R., Jr.

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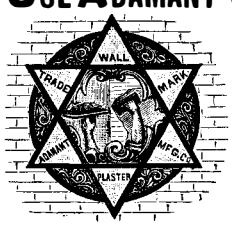

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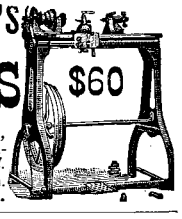

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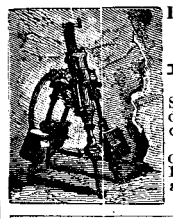

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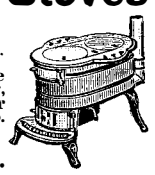

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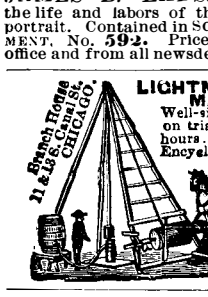

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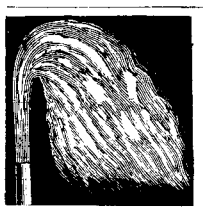

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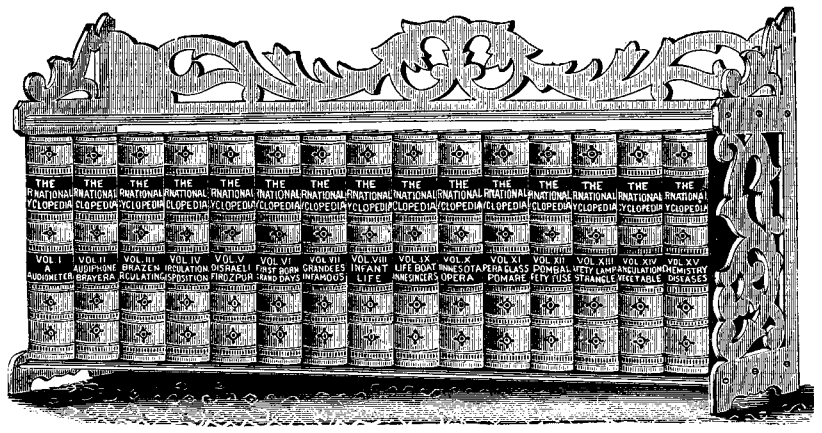

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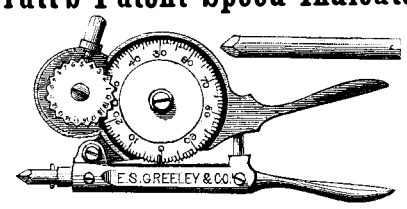

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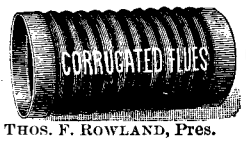

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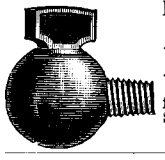

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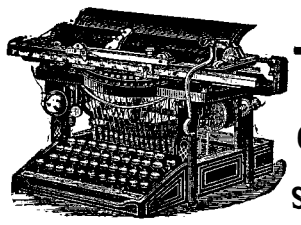

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Hire of Dredging Plant for Improving Housatonic River, Conn.—Engineer Office, U. S. Army, Room 57, Army Building, corner Houston and Greene Streets, New York, February 11, 1889.—Sealed proposals in triplicate for Hire of Dredging Plant for Improving Housatonic River, Conn., will be received at this office until twelve (12) o'clock noon, on Wednesday, March 13, 1889. The attention of bidders is invited to the Acts of Congress approved February 26, 1885, and February 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Further information can be obtained at this office.
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Thirty-ninth Annual Statement

——OF THE——

National Life Insurance Co.

MONTPELIER, VERMONT.

January, 1889.

Premium Receipts in 1888.....	$1,281,173.37
Interest and other Receipts in 1888.	260,364.01
Total Receipts during the year.....	1,541,537.38
Paid to Policy-holders, and for Expenses, Taxes, etc.....	942,050.75
Assets January 1, 1889.....	5,194,112.29
Total liabilities.....	4,373,253.83
Surplus by Vermont, New York and Mass.....	820,858.46
Surplus by Pennsylvania and Maryland Standard.....	1,105,635.53
Policies in force, 16,850, insuring....	32,312,303.00
Policies issued and revived in 1888—5018 insuring.....	11,976,388.00

The Interest Receipts of this Company have exceeded its Death Losses by more than **$190,000!**

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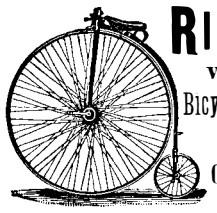

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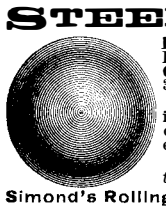

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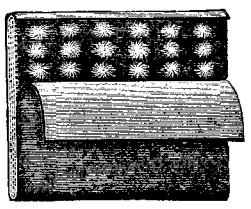

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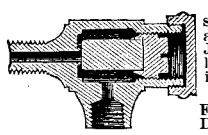

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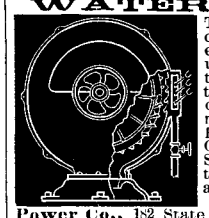

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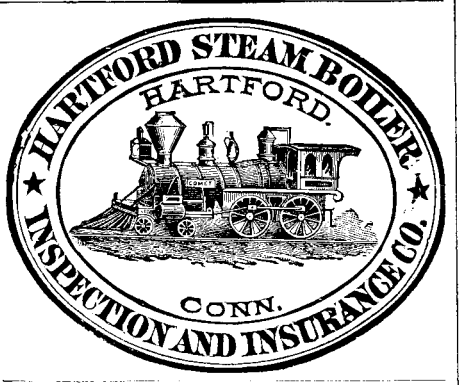

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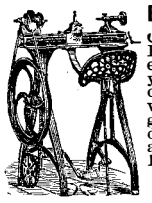

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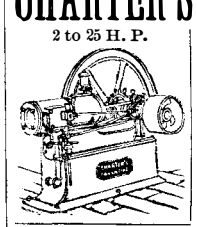

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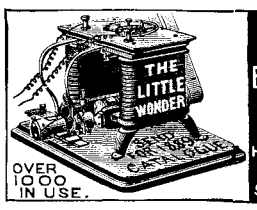

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